Univerzita Karlova

Filosofická fakulta

Ústav pro archeologii

Diplomová práce

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Geneze pravého úhlu v architektuře raného neolitu Předního Východu: ekologické a sociální aspekty rané urbanizce

Vedoucí práce: Doc. PhDr. Jaromír Beneš, Ph.D.

Praha 2021

Charles University

Faculty of Arts

Department of Archaeology

Magister diploma thesis

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Development of right angle in early Neolithic architecture in the Near East: ecological and social aspects of early urbanisation

Supervisor: Doc. PhDr. Jaromír Beneš, Ph.D.

Praque 2021

Prohlášení:

Prohlašuji, že jsem diplomovou práci vypracovala samostatně, že jsem řádně citovala všechny použité prameny a literaturu, a že práce nebyla využita v rámci jiného vysokoškolského studia či k získání jiného nebo stejného titulu.

V Praze, dne 3. srpna 2021

Declaration:

I declare that I have worked on the thesis independently and I have properly cited all the sources. The thesis was not used within another studies or to obtain another or the same university degree.

In Prague, 3th August 2021

Poděkování

Především bych ráda poděkovala mému školiteli, doc. PhDr. Jaromíru Benešovi, Ph.D. za jeho podporu, rady a trpělivost při vedení mé práce. Mé další díky patří Mgr. Jiřímu Bumerlovi za jeho pomoc při získávání klimatických dat, Ing. Arch. Václavu Fantovi Ph.D. a Ing. Jaromíru Kovárníkovi za jejich pomoc při statistickém vyhodnocování a také Mgr. Václavu Vondrovskému za pomoc při zpracovávání radiokarbonových dat.
Dále bych chtěla poděkovat Bc. Tomáši Mladému (Pánu Gisů), za pomoc s mapovými podklady.
Poděkování patří také mé rodině a především Bc. Danielovi Deh Pilařovi za jeho podporu, díky které jsem dokončila tuto práci bez trvalých škod na mém mentálním zdraví.

Acknowledgements:

First, I would like to express my great thanks to my supervisor doc. PhDr. Jaromír Beneš, Ph.D. for his support, advises and patience during the supervision of my thesis.
My great thanks go also to Mgr. Jiří Bumerl for his help with obtaining the climatic dates, to Ing. arch. Václav Fanta, Ph.D. and Ing. Jaromír Kovárník for their help with the statistical evaluation of my thesis and also to Mgr. Václav Vondrovský for his help with processing the radiocarbon dates.
Furthermore, I thank Bc. Tomáš Mladý (Lord of the Gis) for his help with map bases.
I also want to thank my family and especially Bc. Daniel Deh Pilař for his support thanks to which I could finish my thesis without any permanent damages on my mental health.

Abstrakt:

Práce se zabývá změnou kruhového půdorysu staveb na pravoúhlý v období akeramického neolitu stupně B na území Levanty a zkoumáním možného vlivu přírodních podmínek na tuto změnu. Vybraná oblast zahrnuje širokou škálu regionů od území současné severní Sýrie po střední Jordánsko. Lokality pro analýzu byly vybrány na základě chronologických a architektonických kritérií.

Zvolený chronologický rámec práce je vymezen pozdní fází akeramického neolitu A/Pre-Pottery Neolithic A (PPNA; 10 000–9500 BP) a středním stupněm akeramického neolitu B/Pre-Pottery Neolithic B (PPNB; 9200–8500 BP). Klíčovým obdobím je pak raný stupeň PPNB (EPPNB), který je obecně považován za období, do nějž spadají počátky pravoúhlé architektury.

Z důvodu značné tvarové variability napříč severní a jižní Levantou bylo nutné nejen rozšířit chronologický rámec, ale také architektonická kritéria, takže do analýzy byly kromě přechodného půdorysu zahrnuty také stavby čistě kruhové a pravoúhlé. Byla sestavena databáze lokalit, která umožnila porovnat vývoj půdorysu v rámci rozmanitých přírodních podmínek aridních, stepních, i mediteránních oblastí a ukázala relativně široký časový rámec této změny.

V průběhu vyhodnocování lokalit byla hlavní pozornost věnována různorodým přírodním podmínkám severní a jižní Levanty, v rámci kterých byly porovnávány jednotlivé fytogeografické environmentální zóny, nadmořská výška vybraných lokalit, průměrný měsíční úhrn srážek a průměrné měsíční teploty odpovídající střednímu holocénu (hodnoty pro průměrné teploty a srážkový úhrn byly získány z klimatického modelu World Clim-Global climate data). Součástí vyhodnocení jsou také kalibrovaná data ^{14}C. Část analýzy se zabývala vývojem přechodného typu půdorysu v čase napříč jednotlivými regiony Levanty a variabilitou této architektonické změny v rámci jednotlivých chronologických fází.

Výsledky naznačují koncentraci nejranějších forem pravoúhlých staveb v severní Levantě a mediteránních oblastech jižní Levanty s vyšším úhrnem srážek, zatímco aridnější regiony jižní Levanty vykazují delší kontinuitu kruhového půdorysu.

Klíčová slova:

starší holocén – Levanta – architektura pravého úhlu – paleoklimatologie – akeramický neolit PPNA/PPNB

Abstract:

The thesis deals with the change from the circular to a rectangular building during the Pre-Pottery Neolithic B period (PPNB) in the Levant and researches the possible influence of environmental conditions on this transition. The observed area comprises variable regions from northern Syria to central Jordan. Sites for the analysis were selected according to architectural and chronological criteria.

The chosen chronological scope is delimited by final phases of late Pre-Pottery Neolithic A (10 000–9500 BP) and by middle PPNB (9200–8500 BP) periods, with the early PPNB period as a key one, considered as a period of the commencement of rectangular buildings.

Because of the high architectural variability across the northern and the southern Levant, besides the chronological scope also the architectural criteria must be extended. Therefore, circular, and rectangular building shapes were classified too.

A database of Levantine sites was compiled, which enabled to compare distinct development of the ground plan within a diverse environment of the arid, steppe, and Mediterranean territories and revealed a relatively broad time scope of the change. In the process of evaluation, the main attention was paid to the variable environmental conditions of the northern and southern Levant: the individual phytogeographic zone, the altitude of sites, the annual monthly rates of precipitation, and the annual monthly temperatures in the middle Holocene of each site were compared (temperature and precipitation data were obtained from the World Clim-Global climate data modelling). Calibrated ^{14}C data are also integrated into the final evaluation.

Part of the analysis investigated the development of the transitional ground plan in time across individual Levantine regions and the variability of this architectural change within individual chronological phases in general.

The results indicate a concentration of the earliest rectangular forms in the northern Levant and Mediterranean zones of the southern Levant with a higher precipitation rate, while more arid regions of the southern Levant evince longer continuity of circular buildings.

Key words:

early Holocene – Levant – architecture of the right angle – palaeoclimatology – Pre-Pottery Neolithic A/Pre-Pottery Neolithic B

OBSAH

A catalogue of evaluated sites is a part of the thesis. It is enclosed with the thesis separately as an attachment.

List of abbreviations:

PPNA:	Pre-Pottery Neolithic A
LPPNA:	late Pre-Pottery Neolithic A
PPNB:	Pre-Pottery Neolithic B
EPPNB:	early Pre-Pottery Neolithic B
MPPNB:	middle Pre-Pottery Neolithic B
LPPNB:	late Pre-Pottery Neolithic B
EPP:	Epipalaeolithic
eEPP:	early Epipalaeolithic
mEPP:	middle Epipalaeolithic
lEPP:	late Epipalaeolithic
IR-TUR:	Iratno-Turanian (environmental zone)
MED:	Mediterranean (environmental zone)
SA-AR:	Saharo-Arabian (environmental zone)
SA-SY:	Saharo-Syndian (environmental zone)
SU-DE:	Sudano-Decadian (environmental zone)

1. INTRODUCTION

As a part of the urbanisation development in the early Neolithic, a shift from the circular to the rectangular ground plan of houses occurred for the first time in the Near East. This change is chronologically placed in the 10^{th} and 9^{th} millennium BP within the pre-pottery Neolithic B period, and it is related to the environmentally variable territories of northern and southern Levant.

The commencement of right-angled buildings shapes represents a distinct novelty of the early Neolithic settlements development and therefore is a frequented topic within research about Neolithic architecture and socio-economical changes.

The aim of my thesis is to research the possible influence of different environmental conditions on this transition. For the examination, a database of sites from northern and southern Levant, dated from the late Pre-Pottery Neolithic A (10 000–9500 BP) to the middle pre-pottery Neolithic B (9200–8500 BP) was compiled. Besides the chronological range, the important sampling criterion was the presence of both circular, and transitional and rectangular ground plans.

The observed area comprises variable regions from northern Syria to central Jordan and consists of different environments, the Mediterranean, steppe, and arid. The main attention is paid to the annual monthly rates of precipitation, the altitude, the individual phytogeographic zones, and the annual monthly temperatures in the middle Holocene.

First, and the main part of the evaluation, is represented by the examination of individual environmental variables in relationship with the chosen sites and their rate of individual ground plan types.

The second part represents an investigation of the transition development from curvilinear to rectilinear shape in time, and the variability of building types according to the different environments. Therefore, the sites are evaluated according to the calibrated ^{14}C data, and the presence of transitional and curvilinear ground plan.

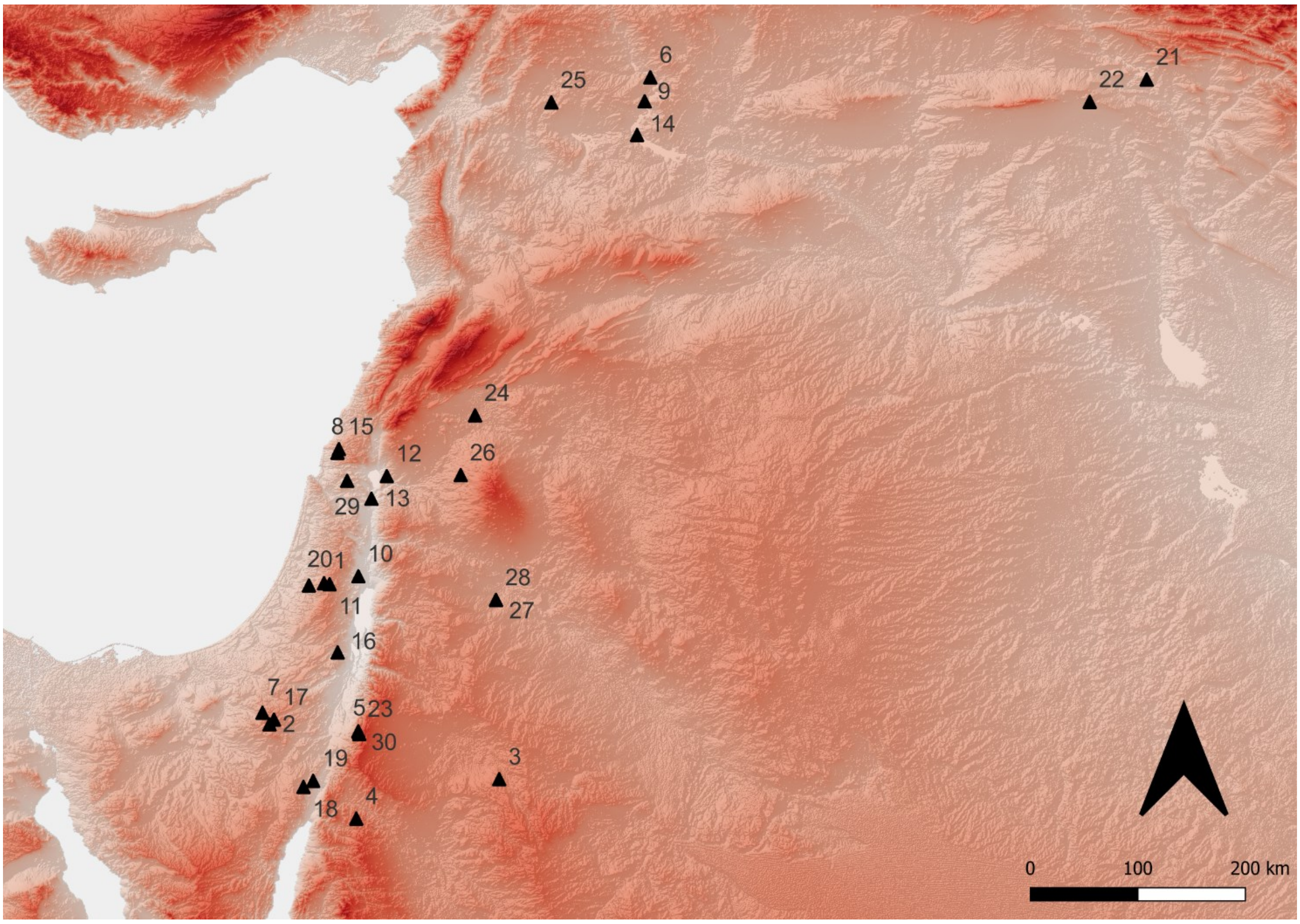

Fig. 1: Map of the evaluated sites.

1.Abu Gosh; 2. Abu Salem; 3. Ainab 1; 4. Ayn Abu Nukhayla; 5. Beidha; 6. Dja´de el-Mughara; 7. Ein Qadis I; 8. Horvat Galil; 9. Jerf el-Ahmar; 10. Jericho; 11. Motza; 12. Mujahiya; 13. Munhata; 14. Tell Mureybet; 15. Nahal Betzet; 16. Nahal Efe; 17. Nahal Hava I; 18. Nahal Isaaron; 19. Nahal Reuel; 20. Nahal Yarmuth 38; 21. Nemrik 9; 22: Qermez Dere; 23. Shkarat Msaied; 24. Tell Aswad; 25. Tell Qaramel; 26. Tell Qarassa North; 27. Wadi el Jilat 26; 28.Wadi el Jilat 7; 29. Yiftahel; 30. Zahrat adh-Dhra´2

2. THEORETICAL FRAMEWORK

2.1 THE OCCUPATIONAL DEVELOPMENT OF LATE PLEISTOCENE AND EARLY HOLOCENE LEVANT

The aim of this chapter is to summarize the cultural development of northern and southern Levant at the terminal Pleistocene and early Holocene, including a brief description of material culture, subsistence economy, and settlement patterns each of individual Epipalaeolithic and Pre-Pottery Neolithic groups. A Pre-Pottery Neolithic B (PPNB) period is left out from this enumeration; since this phase represents a key period within my topic, closer examination and deeper description is required in and an individual chapter is devoted to the PPNB problematic.

The currently generally accepted periodization of the Neolithic period was first proposed by Kathleen Kenyon (Kenyon 1957) establishing the chronology according to her findings at Jericho. Following her four-grade division of Pre-Pottery Neolithic A, B, and pottery Neolithic A, B, my thesis proceeds mostly from the Pre-Pottery Neolithic chronology on the Maison del´Orient by Aurenche et al (Maison del´Orient 1981) and from the periodization by Ex Oriente E.V. based on the compilation and analysis of radiocarbon dates from the sites analyzed within a frame of the SIGN project Dates calibrated with the program OxCal Version 3.1 (https://www.exoriente.org/associated_projects/ppnd.php).

The chronology of PPNB and especially the chronological demarcation of the early phase of PPNB represents an individual issue and it will be closer discussed in the already mentioned PPNB chapter.

dating	Neolithic phases
12 000–10 000 cal BC 12 200–10 200 BP	Natufien
10 000–9 500 cal BC 10 200–10 000 BP	Khiamian
9 500–8 700 cal BC 10 000–9 500 BP	PPNA: Sultanian, Mureybetian Transition phase PPNA-PPNB (Jerf al-Ahmar)
8 700–8 200 cal BC 9 500–9 200 BP	EPPNB (PPNB ancient) (Euphrates: north Syria, southeast Anatolia)
8 200–7 500 cal BC 9 200–8 500 BP	MPPNB (PPNB moyen)
7 500–7 000 cal BC 8 500–8 000 BP	LPPNB (PPNB récent)

Tab. 1: The chronology of early Neolithic phases by Maison del´Orient 1981 (Helmer - Gourichon - Stordeur 2004, Tab. 1)

dating	Neolithic phases
9800/700 (Ph1) 9300/200–8800/700 BC (Ph2)	PPNA
8800–8600 BC	Transitional PPNA/PPNB phase
8600–8300/200 BC	EPPNB
8300/200–7800/500 BC	MPPNB
7800/500–6900? BC	LPPNB

Tab. 2: The chronology of early Neolithic phases by Exoriente (https://www.exoriente.org/associated_projects/ppnd_summary.php)

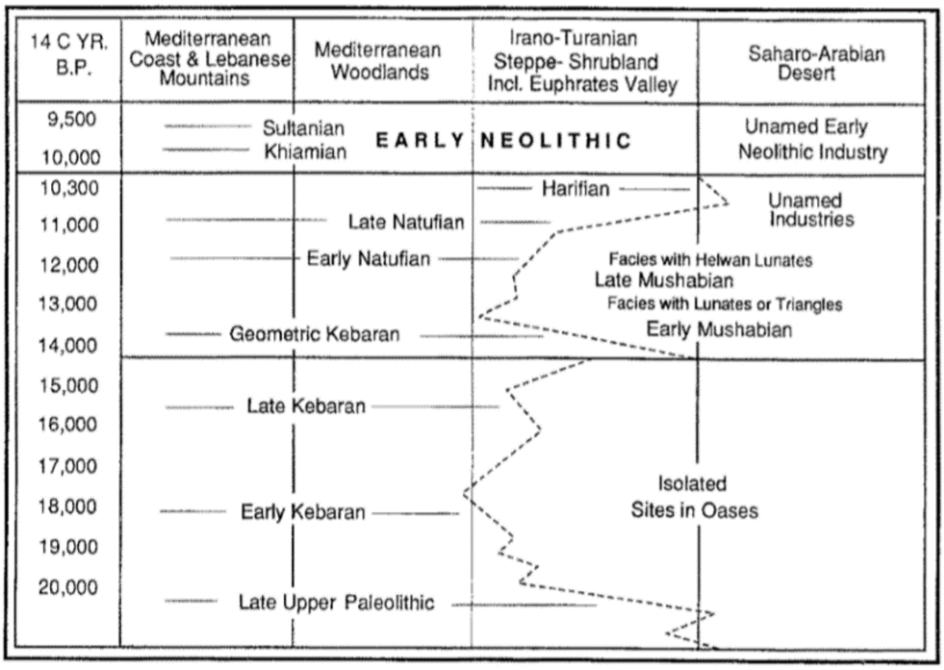

Fig. 2: The chronology of early Neolithic (Bar-Yosef - Belfer-Cohen 1989, Fig. 2)

2.1.1 EPIPALAEOLITHIC

Although the Pre-Pottery Neolithic groups are those primarily essential, for deeper understanding it is necessary to briefly describe also earlier population which preceded the early Neolithic ones. These Epipalaeolithic groups occupied the Levantine area within a broad time span between the last glacial maximum (25–18 cal ka BP; Maher et al 2011) and the beginning of Holocene when they were replaced by early Neolithic societies.

Epipalaeolithic populations can be described as transitional groups occupying the near-eastern Levantine corridor within a broad time span between the Last glacial maximum (25–18 cal ka BP; Maher et al 2011) to ca 11 600 BP under quite variable climatic conditions with series of warming and cooling events (Olszewski 2014, 1) (deeper examination in Environmental chapter).

A huge variety of different cultural groups all over the Levantine area are known, however, several general hallmarks might be highlighted. The Epipalaeolithic groups were predominantly mobile and camp-based, during the late Epipalaeolithic building year

-round small settlements started though (Olszewski 2014, 3). Subsistence strategies followed a traditional palaeolithic model of hunting and gathering; however, it should be seen as a model resulting later in the origins of food production economies and domestication processes.

A common feature of material culture is represented by the stone industry and manufacturing of microliths with backing retouch. This technology differentiates the Epipalaeolithic microliths from the Upper Palaeolithic ones with typically very light retouch (Olszewski 2014, 1). The periodization of Epipalaeolithic might be divided in three phases, early (ca 25 000–19 000 BP), middle (ca 19 000–15 000 BP) and late (ca 15 000–11 600 BP) (Olszewski 2014, Tab. 1).

Kebaran complex (early/middle Epipalaeolithic)

Kebaran complex represents a major group identified in Early Epipalaeolithic (eEPP) Levant: Kebaran populations occupied mostly Mediterranean territories but also areas alongside the Levantine coastal and mountainous range from Anti-Lebanon to southern Jordan and its expansion in semi-arid and arid environments is rare (Bar-Yosef – Belfer-Cohen, 1989, 457). Steppe/desert areas of the eastern Levant were occupied by the Nebekian complex (Olszewski 2014, 3).

Sites were located both in lowlands, mostly alongside wadi courses, and highlands (Samarian or Judean hills, or Golan and Jordanian plateau). Such hilltop sites are considered as seasonal summer camps (Bar-Yosef – Belfer-Cohen, 1989, 457). Their size ranged from 25 up to exceptionally large 1500 m^2, but mostly were 100-150 m^2 (Barker 2006, 111).

The lithic assemblage is represented by predominant bladelets and single-platform cores. For the early Kebaran a large variability is typical, in late Kebaran obliquely truncated backed bladelets and Jiita points appeared, also micropoints and variations of microgravettes. Besides stone tools, burnishers made of horn cores, spatulas, bone points, and marine shells assemblages and pounding and grinding tools are part of material culture (Bar-Yosef – Belfer-Cohen, 1989, 459–61).

Kebaran subsistence economy continued in the upper Palaeolithical traditions, based on hunting gazelles, ibex, and fallow deer. Findings of pounding tools suggest some way of mechanical processing of wild seeds (legumes, cereals, maybe acorns), evidence of aquatic or avian remains are rare (Bar-Yosef – Belfer-Cohen, 1989, 462).

Detected human remains are scarce, possibly due to the state of research. Several semi-flexed burials were discovered in Ein Gev I and in Kharaneh IV. A case of burned multiple burials was also recorded; whether this burial manifestation might be taken as a general Kebaran custom is questionable.

In the context of Kebaran complex, an Ohalo II site should be mentioned. The present-day submerged site provided abundant evidence of the settlement structure and plentiful samples of archaeobotanical material creating a complex picture of the site (Barker 2006, 114; Snir et al 2015).

Late Kebaran was followed by *Geometric Kebaran*, dated from ca. 17, 500–14 600 cal BP in the conventional model (Maher et al 2011, 4). In broader geographical range Geometric Kebaran occurred in the area from Jordan valley through Damascus basin and middle Euphrates (Cauvin 2000) and unlike the preceding Kebaran sites, Geometric Kebaran settled also in semi-arid and arid environments over the Negev, Sinai, and Syro-Jordanian desert.

The size of settlements was similar to Kebaran, small around 15–25 m^2 and others ca 100–150 m^2, but the dimension has never exceeded 600 m^2 (Bar-Yosef – Belfer-Cohen, 1989, 462–63). Most of the buildings contained hearths, in some cases with preserved macrobotanical remains (e. g. Nahal Zin D 5 or Mushabi XIV/2). It is supposed that hearths were located in open space, probably sheltered. Some building layouts enabled to also distinguish a dumping zone with heaps of debitage and knapping area (Goring-Morris 1987, 141).

For the lithic industry, a high frequency of blades and bladelets is typical, shaped mostly into microlithic trapeze-rectangles, especially in areas of Negev and Sinai. This technological specialization might suggest an adaption to specific semiarid environmental conditions compared to the Mediterranean zone (Bar-Yosef – Belfer-Cohen, 1989, 462–63).

Due to the bad preservation conditions of an arid environment, only rare information from animal bones assemblages is available. Most probably fallow deer, wild boars, gazelle, ibex, and hare were hunted (Bar-Yosef – Belfer-Cohen, 1989, 463–64).

Partly contemporaneous with Geometric Kebaran was *Mushabian* complex. Its bearers probably originated in north Africa, within the Nile valley and Nubia (Bar-Yosef – Belfer-Cohen, 1989, 486). North African origin is supposed because of the similarity of lithic tools for which a microburin technique is typical. This type became new in Levantine territories, however, also rare findings of microburin objects are known from Kebaran culture (Bar-Yosef – Belfer-Cohen, 1989, 464). Mushabian complex lasted from ca. 17 500–12 900 cal BP in the conventional model (Maher et al 2011, 4) and settled the territories in northern Sinai and Negev and southern foothills of southern Jordan, favoring Iranio-Turanian and Saharo-Arabian desert environments. The coexistence of those two cultural groups within the arid environment is expected (Bar-Yosef – Belfer-Cohen, 1989, 464).

As the preceding Epipalaeolithic entities, Mushabians were hunters and gatherers operating in semiarid environmental conditions. The demise of Mushabian complex is probably related to the climatic changes of Younger Dryas at ca 13 cal ka BP (Maher et al 2011, 16).

Natufians (late Epipalaeolithic)

Natufian cultural complex represents a distinct late Epipalaeolithic phenomenon formerly considered as direct predecessors of first agricultural societies. Such an approach is now reassessed: objections are mostly grounded on the characterization of lithic tools and their function. Clarification of these objections is dealt below.

In general, the existence of Natufian has been mostly demarcated by two major climatic events; its onset has related to Bølling-Allerød interstadial while the decline with the Younger Dryas cooling. However, according to L. Maher (Maher et al 2011), the correlation between beginnings of cultural complexes and climatic changes is not clear as might have appeared. Maher et al (2011) proposed a possibility that early Natufian (beginning at ca 15,08-14,74 ka cal BP) slightly preceded the onset of Bølling-Allerød period (beginning at 14,67 ka cal BP), about 60–410 years and therefore it is not possible to associate the warm and wet phase with larger and more sedentary campsites in the Geometric Kebaran or early Natufian (Maher et al 2011, 15–16).

The issue with Younger Dryas is less clear and more complicated; in general, the deterioration of climate caused by Younger Dryas is mostly connected to transformations of Natufian social and economic systems, related to resource stress and increased mobility in late Natufian (Maher et al 2011, 16). Nevertheless, models based on the Bayesian analyses show that the early/late Natufian transition took about 13,22–12,97 ka cal BP, i. e. some 53–388 years before the Younger Dryas onset (at ca. 12,9 ka cal BP). In general, L. Maher propose the development of Natufian complex as independent on key climatic events or at least less relasted to them.

The question about Natufian origins is ambiguous as well; the evidence of continuity between the Geometric Kebaran and early Natufian are poor in the archaeological record and recent theories see the possibility of emergence from Mushabian populations in southern Negev and Sinai areas (Grosman – Munro 2017, 705).

The distribution of Natufian sites extends throughout the Levant, from the middle Euphrates to the Negev highlands and along the Jordanian plateau, the highest density of sites is located in the north and central Israel and northern Jordan (Bar-Yosef – Belfer-Cohen 1989, 467). Mountainous areas in Lebanon (Anti-Lebanon Mountains) and the arid areas of the Negev and peripherical desertic zone of the Syro-Arabian desert belonging to the Irano-Turanian zone were marginally occupied. A denser concentration of settlement in arid areas was present only during late Natufian (Bar-Yosef – Belfer-Cohen 1989, 467), during this phase Natufians also reached their northernmost extension, into Syria and Lebanon. Many newly established late Natufian sites continued to be used in the succeeding Pre-Pottery Neolithic A (e. g. Hatula, Nahal Oren Terrace or Wadi Mataha) (Grosman – Munro 2017, 702).

The form of settlement was highly influenced by local environmental conditions. In general, some sites were sedentary, more or less, while another type of adaptation was more mobile and seasonal, including ephemeral seasonal camps or residentially stationary year-round occupation (Grosman and Munro 2017, 702). The settlement sizes vary from 350 to 5000 m^2, while the average size ranges from 1000–2000 m$^{2.}$ The population was estimated up to about 50 individuals, in the case of average large settlements (Barker 2006, 118).

Natufian building´s shape remained semi-circular varying from 4–9 m in diameter, mostly located on terraced slopes (Bar-Yosef – Belfer-Cohen 1989, 468). Bench-like walls were plastered, and findings postholes suggest roofing by organic material. Internal space was divided into rounded rooms (Bar-Yosef, 1983). A heart was usually placed in each of the buildings. Reconstruction the shape of the Natufian houses was based mainly on the structures at the site Mallaha, contributed by findings of wall fragments from sites El-Wad and Nahal Oren (Bar-Yosef – Belfer-Cohen 1989, 468).

An interesting aspect of the Natufian inhabitation is represented by the cave occupation; unlike the Geometric Kebaran and Kebaran populations whose evidence of settling caves are scarce, Natufians apparently occupied the caves as the only Epipalaeolithic group, probably following the upper Palaeolithic cave dwelling traditions (Bar-Yosef – Belfer-Cohen 1989, 467).

The hints of incipient sedentism and change of settlement pattern during the late Natufian represent the most distinctive features of Natufian settlement form and what differs from the previous Epipalaeolithic groups (Grosman – Munro 2017, 702).

The question of Natufian society form and it´s position under the process of early Neolithic societies formation is tightly connected with the material culture display.

Amongst the new stone tool types belong sickle blades and elongated picks (Bar-Yosef – Belfer-Cohen 1989, 468-70) and geometric microliths in a circle form (Cauvin 2000, 15). Besides, ground stone tools are found, mostly pounding tools, portable and bedrock mortars, pestles, cup-marks, bowls, mullers, wet stones, heavy-duty scrapers, shaft straighteners and, hammerstones (Bar-Yosef – Belfer-Cohen 1989, 470). A basic type of stone industry, microburin technique, prevailed from Mushabian complex and this technique is considered as a stylistic attribute varying within different Natufian groups (Cauvin 2000, 15).

Besides the stone tools, Natufian bone assemblage is significant, comparable only to European Magdalenian, regarding richness and variability. Bone tools consisted mostly of hunting, fishing and hide-working tools and basketry aids (Cauvin 2000, 16).

Jewellery and decorative objects are also numerous. Beads and pendants belong to the most often founded objects, mostly made of limestone, basalt, greenstone, malachite, or organic materials such as bones, teeth, and a variety of marine molluscs. The finds of foreign materials such as Anatolian obsidian from Mallaha, greenstone of Syrian or Jordanian provenance, or marine shells originally from the Red Sea or Nile evidence the supra-regional contacts (Bar-Yosef – Belfer-Cohen, 1989, 470). Natufian bone work is also significant; the most decorated objects were placed in the burials.

Mostly the depiction of deer of gazelle appeared (Barker 2006, 127; Cauvin 2000), however the depiction of anthropomorphic motifs is also abundant, i. e. most recently at Raqefet Cave (Rosenberg et al 2020, 129).

As stated before, for some time Natufians were considered as the first cereal cultivators. However, according to recent conclusions, Natufian populations most probably collected cereals intensively, but not cultivated them. This conclusion is based on the microwear studies which proved harvesting plants but unripe or green (wild cereals had brittle rachises unlike the modern domesticated tough rachises). Moreover, the consequences of systematic cultivating would have displayed rapidly. On the other hand, the consummation of cereals is most likely, and other microwear studies made on sickles give an evidence for tillage; Natufians might beginning to intervene to enhance cereal growth then and this form of subsistence might support permanent settlements development, more or less (Barker 2006, 126).

Natufian burials are typical for their huge variability and differ in many parameters, for example, dissimilarity in position (flexed, semi-flexed, and extended), a number of buried individuals in a grave, the structure of the grave itself and type of decoration (Bar-Yosef – Belfer-Cohen 1989, 473). Mostly only single-person burials appeared, although also multiple graves are known (Bocquentin – Garrard 2016, 1). Those divergences are considered either to represent variations within Natufian culture and society in terms of social stratification or reflect the development through time (Bar-Yosef – Belfer-Cohen 1989, 473).

To late Natufian the beginning of the practice of burying skulls separated from rest of the body is also attributed (Bar-Yosef – Belfer-Cohen 1989, 473). The earliest evidence comes from Hayonim cave (Belfer-Cohen, 1989). This mortuary practice later became the most significant during PPNB.

2.1.2 PRE-POTTERY NEOLITHIC A

The emergence of the earliest Neolithic populations is placed at the boundary of Younger Dryas and Preboreal in the 12th millennium BP (Maher et al 2011, 17). The onset of Preboreal period is connected to rapid warming and increased rate of precipitation and it is tempting to connect the cultural and social changes with the early Holocene climate amelioration. Despite generally accepted influence on the Palaeolithic-Mesolithic transition in Europe, the effect on the early Neolithic communities is questionable (Maher et al 2011, 8). According to reassessed data by Maher et al (2011), the onset of Preboreal climate might be placed after the PPNA beginning, which she dates at 11,9–11,7 ka cal BP which means that the earliest Neolithic communities probably still fall under the very end of Younger Dryas (Maher et al 2011, 17).

Recognition of the earliest near eastern Neolithic populations was accomplished by Kathleen Kenyon at Tell as Sultan (Jericho) site, where she defined two main strata distinguished as pre-pottery Neolithic A and B (PPNA/B) phases. During the following research, PPNA was further subdivided.

PPNA complex occupied the area of the whole Levant, both North, and South. Some scholars identify several distinct cultural entities existing within the PPNA complex, distinguished by the areas of occurrence and material culture: a) Khiamian/Sultanian occupied the south-central Levant, b) Khiamian/Sultanian/Mureybetian in the Middle Euphrates territory of Northern Levant, c) the area of "Round-house horizon" along the Upper Tigris[1], d) Cypriot PPNA, e) and the "Initial PPNA" of central Anatolia (Goring-Morris – Belfer-Cohen 2016, 185). For the purposes of this overview, I will closer examine only two main local manifestations of southern and northern PPNA, Khiamian/Sultanian and Mureybetian.

The mutual relationship of Khiamian and Sultanian groups is a complicated question without a consensus. According to one model, two independent "cultures" existed within the PPNA, *Khiamian* and *Sultanian* (i. e. Crowfoot-Payne 1976), with Khiamian chronologically placed between the late Natufian and Sultanian and described also as "epi-Natufian" (Bar-Yosef – Belfer-Cohen 1989, 474; Cauvin 1977). The second model rather perceives the Khiamians as a part of Sultanian cultural group, differed only by specific lithic assemblages, so-called Khiam points (Nadel 1990, Gopher 1985).

[1] Round-House Horizont (RHH) represents a distinctive cultural horizon of Taurus-Zagros area spanning the period from 11th millenium to the end of the 10th/beginning of the 9th millenium BP, i.e. the period of late Natufian and PPNA in Levant. The horizon was roughly contemporary with all PPNA phases (IA to the first part of IVB at Mureybet). The end of RHH is connected to the onset of PPNB (Peasnall 2000, 487–488).

According to Maher et al (2011), whether we recognize Khiamian group as independent, it would be theoretically possible to connect it with the end of Younger Dryas, while the settled village life of Sultanian group might be related to the onset of the early Holocene (i. e. Byrd 2005, 252). Unfortunately, the useable data of Khiamian sites are too scarce (only from Hatoula and Wadi Feynan 16), overlapping too much with the Sultanian ones and overall do not give a convincing impression of chronologically well-defined unit (Maher et al 2011, 17).

However, this summary follows the model of the dominant Sultanian group with the very beginnings at the turn of the Younger Dryas and Preboreal (11,9–11,7 cal ka BP) with most probably onset falling slightly under the Younger Dryas conditions.

In many aspects, the PPNA followed Natufian traditions. Burial practices similar as in the late Natufian mostly consisted of a single individual without grave goods. Sometimes, the underfloor burials and special treatment with skulls appeared (i.e., Netiv Hagdud; Bar-Yosef – Belfer-Cohen 1992, 36). The composition of the lithic industry also corresponds to the Natufian in sense of using microliths and heavy-duty tools (picks, adzes), blades, and grinding equipment. A gradual replacing of mortars and pestles by hand-stones and querns is obvious (Barker 2006, 134).

A significant change is observable in the settlement pattern where the phenomenon of huge settlements and monumental buildings appeared for the first time (Cauvin 2000, 38). Sites were located mostly in lowlands, while arid areas remained poorly occupied. Individual dwellings consisted of dispersed, short-lived single storeys, of circular or oval shape semi-subterranean structures. They served probably for nuclear family accommodation. Structures were constructed of wattle and daub or mudbrick on stone foundations. The roofing was supported by wooden posts or beams, floor was made by *pisé* technique (Goring-Morris – Belfer-Cohen 2013, 22). Typical Sultanian house consisted of a single unit, although in Jericho and Netiv Hagdud two units were discovered (Naveh 2003, 85).

Mureybetian group represents the northern Levantine PPNA manifestation. The architectural arrangement is similar to the southern PPNA group: the house´s shape was rounded and semi-subterranean or built on the surface by the *pisé* walls construction with stone foundations (Cauvin 2000, 39). Subterranean buildings were supported by wooden posts covered by clay, while floors were lined with slabs or pebbles (Bar-Yosef 2008, 130). Constructions were probably roofed by flat mud roof (Cauvin 2000, 41). Mureybetian architecture represents an important step within the development of quadrilateral structures; this problematics is closer discussed in the chapter about the development of PPN architecture.

The stone assemblage is represented by a characteristic new technique of making leaf-shaped blades and arrowheads, heavy adzes and scarpers, made of obsidian or flint (Bar-Yosef 2008, 131 - Cauvin 2000, 44), also local lozenge-shaped Nemrik points appeared (Goring-Morris – Belfer-Cohen 2016, 189). The ground stone industry consists of querns and bowls. At Jerf el-Ahmar, a communal kitchen facility for food preparation was recognizes (Stordeur 2014).

Concerning the burials, the pattern is similar to southern PPNA groups. A few examples of skull removal are evidenced (Jerf el-Ahmar, Mureybet), as well as under-hearth interieur burials (Cauvin 2000, 44).

Within the PPNA complex, a third distinctive group existed, the *Aswadian*. It was recognized at the Tell Aswad site and defined solely by characteristic lithic tools. Therefore, Aswadian group represents only small-scale phenomenon. Tell Aswad is located on the eastern margin of the Anti-Lebanon mountains and likely as Mureybetian, it belongs to the northern Levantine cultural-geographical scope. The site is dated to the very end of PPNA or to already early PPNB 9300 BP/ ~8300 cal. BC (Edwards 2016, 63). The village consisted of small semi-subterranean buildings (2–3 m in diameter) accompanied by cylindrical pits around, which served probably as silos.

The characteristic feature of Aswadian lithic assemblages was represented by typical arrowheads, Aswad points, which were derived from Khiam points, by blades with a lustred edge whose size was larger than Sultanians. Besides stone tools also anthropomorphic and animal clay figurines occurred at Tell Aswad (Cauvin 2000, 39).

The question of the overall characterization of PPNA complex is tightly bounded with the form of subsistence strategy. This issue has been reassessed in relatively recent time and became crucial in the context of wider comparing of individual phases of Pre-Pottery Neolithic and their understanding.

For a long time, a PPNA populations were considered as the first intensive plant cultivators (i. e. Bar-Yosef – Belfer-Cohen 1989, 482). However, according to the current archaeobotanical data, the earliest domesticated species belong to the latest phases of PPNA, and mainly to the PPNB complex, where the core of domestication lies (Asouti – Fuller 2012, Beneš 2018). Therefore, Khiamians/Sultanians and Mureybetians can be described as settled hunters/gatherers and wild plants and cereals exploiters (barley, oats), together with nuts and figs. Especially in northern Levantine PPNA province, the intensification of animal manipulation is substantial (Goring-Morris – Belfer-Cohen 2016, 189; Zeder 2011). Closer examination of this issue will be given in the *Domestication* chapter.

An important part of understanding the nature of PPNA society is the character of the symbolic and ritual world. In many aspects, the burial and symbolic practises follow the Natufian tradition (i. e. skull removal or burials accompanied by animals). However, distinctive changes are manifested mainly by the novelties in architecture, especially by the appearance of communal structures ("kiva-type communal structures"), evidenced at Wadi Feynan 16, Göbekli Tepe or Jerf el-Afmar (Goring-Morris – Belfer-Cohen 2016, 187-188). Among important elements of the PPNA symbolism belong also meander motifs (i. e. Netiv Hagdud or Mureybet III) and the role of aurochs, more precisely "the women and the bull" concept, considered as a new ideological system (Cauvin 2000, 28).

2.1.3 PRE-POTTERY NEOLITHIC B

During the second half of the tenth millennium BP, the cultural complex of PPNA was replaced by a Pre-Pottery Neolithic B (PPNB) period which was characterized by the sum of new cultural aspects. Together with other novelties in material culture and social and economic organisation, first rectangular buildings, and large settlements as the predecessors of later huge urban units appeared during this period. Therefore, the PPNB period represents a key epoch for my thesis.

Besides, PPNB holds an exceptional status within the Neolithic research for being the first recognized "aceramic" Neolithic culture discovered in the Near East by John Garstang´s excavation at Jericho in the 1930s. The complete picture of the stratification was filled in by Kathleen Kenyon after the second world war (1952–1958) when she distinguished the PPNB from the earlier overlying Sultanian (PPNA) phase (Cauvin 2000, 79).

The PPNB is commonly divided into early (EPPNB): 8600–8200 BC, middle (MPPNB): 8200–7500 BC, and late PPNB (LPPNB): 7500–7000 BC (Cauvin 2000). However, what should be mentioned here is the plentifully discussed issue of PPNB origins and the way of its development in Levantine corridor. The initial phase of PPNB, the EPPNB, is an object of many discussions and it is bounded also with questions concerning the formation and dissemination of the PPNB cultural traits.

In general, there are two tendencies how to approach this topic: in one perspective the EPPNB phase occurred solely in the northern Levant and from there diffused southward. This chronological model of PPNB dispersal from the north was first proposed by I. Kuijt (1997, 2003). Based on Kuijt´s analysis, the northern PPNB began at 9500 BP/8800 cal BC while the southern after 9300 BP/8600 cal BC. This opinion is shared also by Edwards (Edwards 2016) or Cauvin (Cauvin 2000) who distinguishes three waves of spreading the PPNB: the earliest one in EPPNB penetrating the southeast Anatolia, during MPPNB phase around 8200–7500 BC dismissing to the south Levant and in LPPNB extending beyond the nuclear zone of the Levant as the key zone of the Neolithic development (Cauvin 2000, 76).

This assumption about the southward dissemination is based merely on the radiocarbon dating of several transition EPPNB sites in northern and southern Levant (e. g. Mureybet, Dja´de al-Mughara, Zahrat adh-Dhra´2, ´Ain Ghazal, Motza) which were enriched by some newly dated sites in analysis in 2014 (Tell ´Abr 3, Tell Ain al-Kerkh, Tell Qarassa North, Beidha). A key site in this discussion is the northern Levantine site Mureybet, dated by Cauvin as 9600 BP/9000 cal BC, which is the primary source of Levantine PPNB chronology. (Edwards 2016, 57). With Mureybet correspond the data from Dja´de al-Mughara (9600/9500 BP) and Tell ´Abr 3 (ca 9600/500 BP). Also Tell Ain al-Kerkh might be probably determined as an early site, based on the presence Helwan and Aswad point if we accept their presence as a marker of EPPNB (Edwards 2016, 63).

According to Edwards (2016), there is not any EPPNB site in the southern Levant. He finds using this term as probably chronologically misleading under south Levantine cultural conditions and he believes that PPNB did not penetrated the southern Levantine area until the middle phase of PPNB. Despite some incongruities in interpreting the radiocarbon dating from transition sites, Edwards finds the existing proofs of northern PPNB provenance (namely in northern Syria) as sufficient. However, he does not perceive the sum of PPNB novelties as a compact package but as a series of pulses while each of its facies was distributed in a limited time- and territory-frame, and each facie should be regarded with its own terminology (Edwards 2016, 69).

On the contrary, some evidence speaking for the existence of EPPNB in south Levant: as proposed by Khalaily et al (2007), Motza should be dated to EPPNB. Based on the results of excavation in 2002–2003, the site provided several radiocarbon dates all falling in the range between 8600–8200 cal BC and also assemblages of Helwan points and stone tools processed by naviform technology which are commonly taken as markers of EPPNB, including Edwards himself (Edwards 2016, 63). Adherents of the idea of simultaneous development of PPNB see the major problem of proving the EPPNB existence in the south Levant in the small number of radiocarbon dates available from excavated sites (Khalaily et al 2007, 6). Unlike Edwards (2016), who perceives the situation at Motza as an image of rapid change from PPNA to PPNB and as the evidence of southward dissemination of PPNB from the north, Khalialy et al see Motza as proof of EPPNB existence in south Levant.

One of the most distinctive features of the PPNB phase is the broadly discussed phenomenon of PPNB *koine*. During the tenth and ninth millennium, it is possible to observe a considerable unification of material and cultural manifestation within relatively large territory of northern and southern Levant. This unification displayed in several categories of profane and ritual behaving: in material culture, subsistence strategy, and economic and probably social organisation. For the first time rectangular buildings and larger settlements appeared, PPNB also represents the very beginning of agriculture when plants and animals occurred in their fully domesticated forms for the first time.

However, the issue of cultural unification is questioned by some scholars and its definition is not agreed by all. Also, the approaches to the characterization of this unification vary. J. Cauvin does not perceive the PPNB as a chronostratigraphic marker or a being developed from regional cultures but more as a different cultural system with the origin in the northern Levant. According to Cauvin, the character of PPNB was expansionist, penetrating peripheral areas. This approach is closely connected to the overall viewing of ´cultural supremacy´ over the agricultural development (Asouti 2006, 93). On the contrary, a ´polycentric model´ of the Neolithic transformation is proposed, emphasizing the regional diversity (e. g. Rollefson – Gebel 2004). In general, polycentric models are based on hypothetical reconstructions of local cultural continuity and opposing the diffusionist approach (Asouti 2006, 94–95).

Another approach reflecting the highly variable cultural environment throughout Levant containing population movements and PPNB cultural domination (Asouti 2006, 100) is represented by the ´PPNB interaction sphere´, described by Bar-Yosef and Belfer-Cohen (1989). The concept assumes acculturation as a significant socio-economic dimension and distinguishes two basic settlement Levantine patterns, ´core´ and ´peripheral´ areas of the Mediterranean and arid zones (Asouti 2006, 100). This duality is by Goring-Morris and Belfer-Cohen displayed in several social-economical categories: inter- and intra-site settlement pattern, social and economic status, territoriality and exchange, and the interaction between the desert and the sown lands, (Bar-Yosef - Belfer-Cohen 1989, 66) i. e. between the non-permanent desert groups and PPNB villages.

Besides the disunity in diffusionists and polycentric models of PPNB manifestation, also the character of the PPNB unification is unclear. Edwards does not (2016) see the phenomenon of PPNB directly as a package or ideology but more as a "*polythetic cluster of material culture traits and behavioural practices*", while some of them might be derived from the north and some could emerge autochthonous as regional variations (Edwards 2016, 54). Despite these objections, the changes stated above which were brought by the ´PPNB novelties package´ are indisputable. Watkins (2008) points to distinct local variations of PPNB within processing stone tools and building techniques. Those objections are part of his wider critique of the concept of ´cultural groups´ (Watkins 2008, 153).

Besides the changes in settlements and households which are discussed within individual part, it is possible to distinguish another three notional categories of new aspects within PPNB populations: material culture, subsistence strategy, and economical changes, and symbolic and religious sphere. A typical shape of stone tools, a ´hallmark´ of PPNB stone assemblages is a bidirectional naviform chipped stone technology. Such a technique provided the production of elongated symmetrical blade blanks used for more standardized tool classes as sickle blades, large, complicated types of arrowheads

(Helwan and Aswad points), bores, and burins. An exceptional type of tools is the eponymous Nahal Hemar knife (Goring-Morris – Belfer-Cohen 2014, 158).

Generally, the PPNB assemblage of lithic technologies shows increasing efficiency by the use of bipolar-flaked cores and pressure flaking to produce blades serviceable for diverse activities, such as hunting, harvesting, heavy-wood working or craft production (Barker 2006, 139).

Helwan points and its variant, Aswad points are considered as EPPNB markers. Because of specific features such as parallel-sided blade blanks with two pairs of opposed nitches and sometimes bifacial trimmed bases by some scholars are seen as a different type of point, independent on the northern Syrian Helwan type. The appearance of Helwan points in the northern Levant is demarcated by MPPNB when they were replaced by new types (Edwards 2016, 66). During the final PPNB ´Tuwalian´ stone industry appeared which is characterised by large cortical knives (Goring-Morris – Belfer-Cohen 2014, 159).

To numerous other types of tools belong querns and hand-stones, also fragments of cordage and basketry are found (e. g. Abu Hureyra). A Nahal Hamar cave is an example of a site rich in this type of hunting and household tools: remains of mats, baskets, vessels, nets, and quivers were discovered there. The beginning of manufacturing of large vessels made of gypsum and lime plaster, so-called ´White Ware´ is also characteristic (Barker 2006, 139).

An important phenomenon of the PPNB period is an intensification of exotic prestige items exchange. These exchange traits continued in the patterns begun in PPNA – objects such a freshwater molluscs, obsidian, cinnabar, asphalt, and various types of greenstones were transported from Transjordan, Saudi Arabia, Sinai, and Arava, from areas in northern Syria, on Cyprus, Iraq, and also central Anatolia. Similarly, as in PPNA, those objects were used as (probably) votive axes, cylinders, in the shape of beads, pendants, or polished pebbles (Goring-Morris – Belfer-Cohen 2014, 159). Also increasing standardisation of artefacts is noticeable which might indicate the dawn of craft specialization with relation to ensuring surplus food for the craftsperson or the ability to gain food from other households in return for specialized products. Such a shift in social relationship within community and subsistence strategy is related to the development in agriculture and wider changes in subsistence strategies at all: nevertheless, we lack deeper knowledge about such exchange systems operating at the local level (Barker 2006, 142).

The indispensable issue of plant and faunal domestication is not mentioned here and it is dealt with below in the individual chapter.

A ritual and symbolic segment of human life belongs to one of the most significant changes of the PPNB period: however, a deeper analysis of those is not the aim of this paper, therefore only a brief summary of key points the ritual sphere development is present here.

During PPNB a clear intensification of ritual activities is observable. Intensified ritual behaviour and customs are well reflected in burial customs: dead were commonly buried within the settlement, specifically under floors or clay benches (Barker 2006, 143). Despite the often findings of within-settlement burials, they are often insufficient for the settlement size and its intensity, therefore also some off-site disposal of some deceased is considered, e. g. Kfar HaHoresh (Goring-Morris – Belfer-Cohen 2014, 156). Frequently, but not always, a skull cult occurs. This post-mortem skull removal tradition has roots in PPNA and Natufian societies: selected skulls of both sexes and children were plaster modelled in facial features (Jericho, Kfar HaHoresh, Yiftahel, ´Ain Ghazal) or with modelled wigs (Nahal Hemar). Commonly the forms of burials vary a lot, including deposition in plaster-capped pits, cists, walls, or hearts) however, also special treatment with bodies is known, such as dismemberment or manipulation of corpses. Grave goods were placed in and around burials, mostly lithic tools, molluscs, polished pebbles, and animal motifs (Goring-Morris – Belfer-Cohen 2014, 156). By the beginning of late PPNB (LPNNB) sometimes multiple, carefully arranged burials appeared, however reasons for this change are unclear (Goring-Morris – Belfer-Cohen 2014, 158).

Other elements that manifested the behaviour which we might call ´a ritual’ or ´symbolic´ are present in stone zoomorphic and anthropomorphic figurines, stone masks are typical (Nahal Hemar) and large lime-plaster sculptures (Jericho) which are common especially in the areas of Judea (Goring-Morris – Belfer-Cohen 2014, 158).

In general, a tendency towards increasing social differentiation and complex ideologies is apparent, clearly visible in the structures of some sites, e. g. Nemrik, Çayönü Tepesi and especially Çatalhöyük in Anatolia.

Many new factors projected into the PPNB world, such as farming, enlargement of settlements with more stable houses together with much clearer separation of the domesticated landscape from the wild (Barker 2006, 144), and more elaborated and sophisticated treating with deceased bodies. Each of these social-cultural components influenced and was influenced by others which created a complicated melting pot of pre-pottery societies climax.

2.2 ENVIRONMENTAL FRAMEWORK

2.2.1 THE NORTHERN AND SOUTHERN LEVANTINE ENVIRONMENT

In general, the area of Levant is demarcated by the area between the Taurus-Zagros mountains to the southern tip of the Sinai Peninsula (~ 800 × 250 km) (Avni Y. 2017, 3) to the north and the Syro-Arabian desert to the east (Goring-Morris et al 2009, 186). However, the demarcation of the Levantine area might differ according to the geographical or historical viewpoint. Despite the relatively small area, the high environmental diversity is characteristic for the Levantine territories. Such heterogenous conditions including wetter Mediterranean coastline, mountainous regions, lowlands, and extremely dry arid areas of deserts enabled the existence of a number of different subsistence and settlement settings during Epipalaeolithic and early Neolithic.

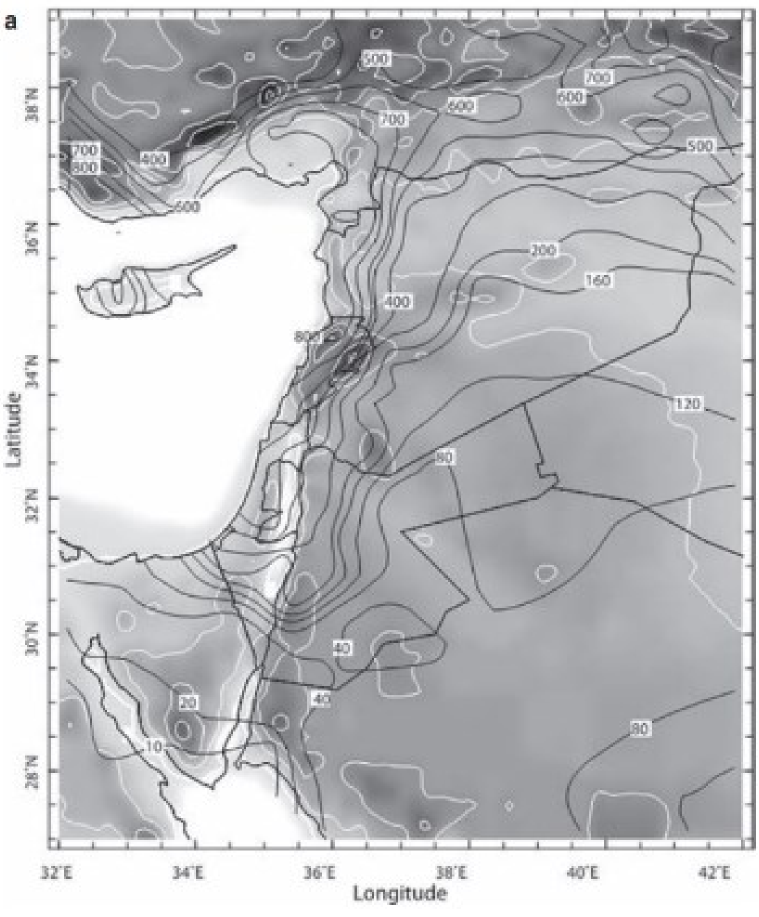

Figure 3: Annual precipitation in Levant based on station observations by the Global Precipitation Climatology Centre (GPCC) Project (Kushnir et al 2017, Fig. 4.1)

Climate and precipitation

The Levant is characterized by a dry warm and wet cold season (Kushnir et al 2012, 39). The seasonal climate is influenced by two major climatic systems, the Atlantic one (originating in the west) and the north African and southwestern Asian monsoon systems (Goring-Morris et al 2009, 186). Amongst the other main factors influencing present-day Levant´s climate belongs primarily the proximity of the Mediterranean Sea and the shape of its coastline. The orography strongly influences the amount of annual rainfall; the southern Levant coastline is oriented i to the moisture-bearing air masses that move further east from the Mediterranean Sea (Kushnir et al 2017, 31). On the eastern side of the mountain range and in the Rift Valley the "rain shadow effect" exists (Gorin-Morris et al 2009, 186).

Rainfalls mostly occur in spring and winter (from November to May) but also short and intense during the summer months which mainly affects the arid areas (Soto-Berelov 2012). This type of precipitation is characterized by short duration, small spatial extent, and high rain densities and it might mostly cause a high-magnitude flash flood (Kushnir et al 2017, 39).

Geomorphology and physiographic setting

Levantine topography is characterized by a longitudinal alternation of elevated and low regions (Goring-Morris et al 2009, 186). The overall physio geographic pattern is constrained by the setting of the Levant which is situated at the convergence of the northeastern African and northwestern Arabian plates and the eastern Mediterranean Levantine Basin. The present physiography of the Levant was evolved mainly since the Late Miocene; however, some features were developed also during older tectonic events (Avni Y. 2017, 3).

Within Levant, several geographic units are recognized. **The Lebanon range** is the highest in the Levant (120 x 40 km, the highest peak at 3083 m) and is bordered by the Mediterranean coast in the west and the Yammouneh fault and Bekaa depression in the east. **The Anti-Lebanon** (ca 200 x 30 km, the highest peak at 2629 m) and the **Hermon ridge** (ca 40 x 15-20 km, the highest peak at 2814 m) merge with the Syrian Desert (Avni 2017, 7).

From the Golan Heights to the Harrat Ash Shaam volcanic fields extends the **northeastern Basalt plateau**, encompassing the of ca 250 x 150 km. The summit reaches altitudes of 1700 – 1800 m along with the mountain range of **Jebel Druze** (ca 70/80 km long and ca 40 km wide). The terrain gradually decreases from the Jebel Druze range to a volcanic plateau with altitudes of ca 700 m in the Syrian desert to the east and to the western Golan plateau (altitudes of ca 300 m) (Avni 2017, 7).

Another unit is the **Jordanian plateau**, located between the Jordan valley, Dead Sea, and Arava valley in the west and Arabian Peninsula in the east, which takes up 300 km in length and 60–180 km wide. The summits reach altitudes at 1200 – 1700 m with the elevation increasing southward (Avni 2017, 7).

The central mountain chain constitutes of elevated belt that extends from southern Lebanon to the central Negev and it is intermediate between the central depression in the east and the Mediterranean coastal plain in the west. Its summits reach 800–1200 m (Avni 2917, 9).

The southernmost geographic unit of the Levant, **The Sinai Peninsula, and the northern tip of the Red Sea***,* is stretch over a relatively large territory (350 x 200 km). The altitudes range between 2500 and 2600 m (Avni 2017, 10).

The western coastal plain is represented by a lowland area, located along the continental margin of the Levant (Avni 2017, 10).

Perennial rivers or streams are relatively sparse today; among the most significant belong Tigris, Euphrates, Ásí (Orontes), and Jordan. Other drainages are mostly seasonal and ephemeral. Within both the Mediterranean zone and arid area springs occur (Goring-Morris et al 2009, 186).

Phytogeographic zones

The specific conditions of microenvironmental zones across the Levant lead to the definition of distinct phytogeographic zones, i.e zones based on the geographic distribution of plants. The first plant geographical map was drawn up by Eig (1931/32), recognizing three areas, Mediterranean, Irano-Turanian, and Saharo-Sindian (Danin – Plitman 1987, 43). His map was followed by similar sorting by Zohary (1962, 1966), with Sudano-Decadian zone in addition.

These zones represent the default sorting for most of the later revisions; the latest one from Soto-Berelov (2012). More detailed characterization of individual zones will follow in the deeper description of both southern and northern Levant conditions.

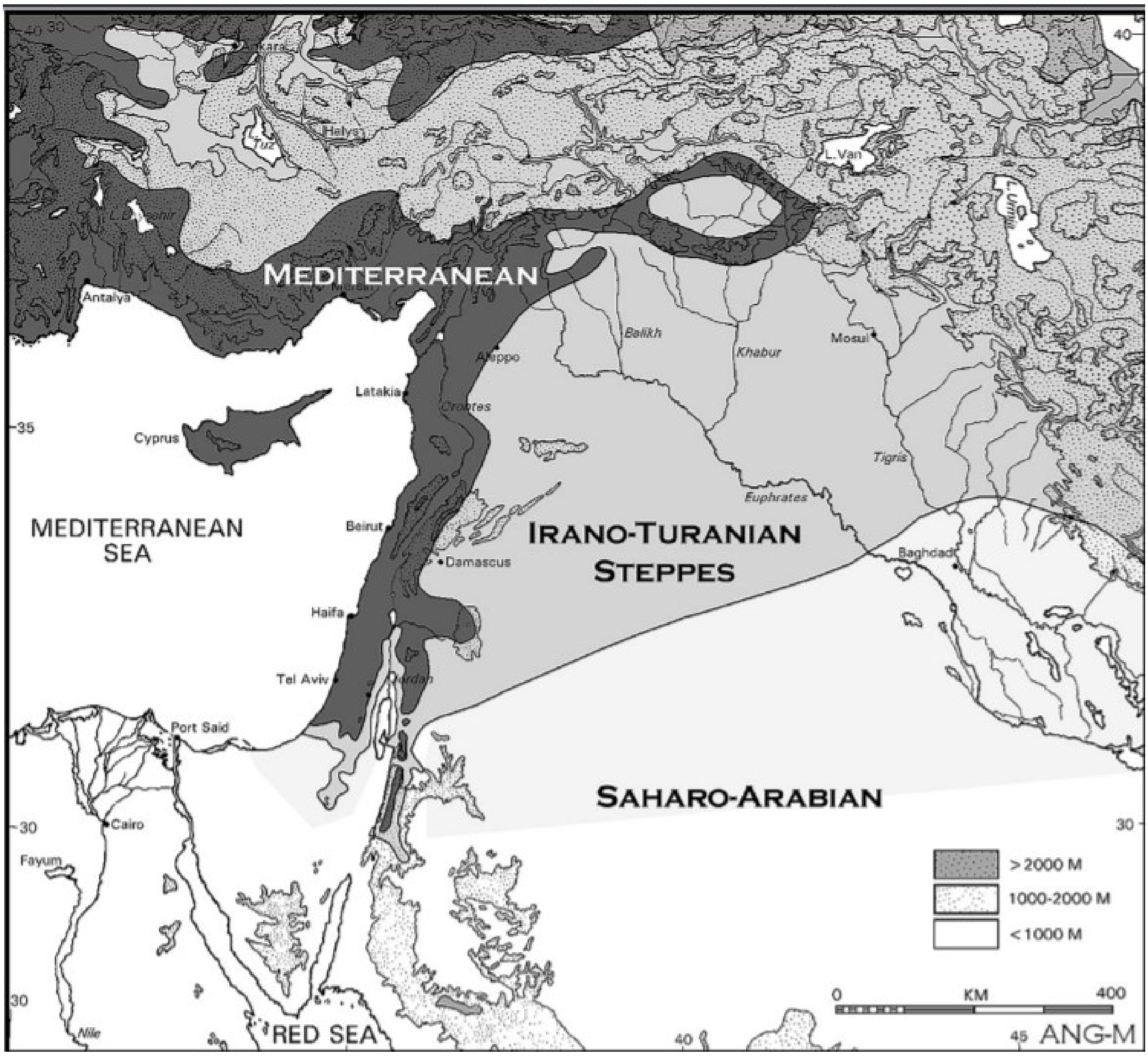

Figure 4: Map of the phytogeographic regions of the Near East (Goring-Morris – Belfer-Cohen 2010, Fig. 2.1)

South Levant:

The area of southern Levant encompasses about 42,650 km^2 containing present-day Israel, (including Palestine Authority territories) and Jordan, The precipitation number decreases from west to east and from north to east (Soto-Berelov 2012, 2). In general, 75–85 % of precipitation in Israel and the Levant is associated with the eastern Mediterranean cyclones. Besides, there is relatively high inner-annual rainfall variability. The coefficient of variance (= the ratio between the standard deviation and the mean) increases with aridity from ~0,2 in the northwest Levant to > 0,5 in the southern and eastern Levantine deserts (Kushnir et al 2017, 39).

Within the southern Levant, mostly two elementary zones are sorted, Mediterranean and Steppe/Desert zone (Gorring-Morris – Belfer-Cohen 1997, Tab. 1)

The latest revised map by Soto-Berelov (2012) proceedes from Zohary´s map from 1966, defining Mediterranean, Irano-Turanian, Saharo-Arabian, Sudano-Decadian and Tropical Sudanian zones:

Mediterranean

The Mediterranean zone includes the wettest areas located near the Mediterranean coastline and generally in the higher elevations (Sea of Galilee, northwestern coastal region). Prevailing florae in these regions constitute pine (*Pinus halepensis*) and deciduous and evergreen oak (*Quercus ithaburensis* and *Q. calliprinos*). The less moisture areas within the Mediterranean zone occur both west of the Rift valley, in areas surrounding the Central Hills, comprising more open woodlands of caroob and pistacia (*Ceratonia siliqua* and *Pistacia lentiscus*) and east of the rift on the southern highlands of the Jordanian plateau, with open woodlands of juniper (*Juniperus phoenica*) and evergreen oak (*Quercus calliprinos*) (Soto-Berelov 2012, 3).

Irano-Turanian

The Irano-Turanian represents a transition zone between the more humid Mediterranean and arid Saharo-Arabian regions. The number of annual precipitations ranges from 150 to 350 mm/yr. More extreme temperatures are typical for this zone, ranging from 12–25 °C and 5–20 °C. the vegetation has a steppe character, consisting of grasses and shrubs *(Artemisia herbaalba)* and scaterred trees (*Pistacia atlantica* and *Juniperus phoenicia*) (Soto-Berelov 2012, 3-4).

Saharo-Arabian

For Saharo-Arabian zones a very low number of precipitations is typical, mostly not exceeding 200 mm/yr. Summers are extremely dry with sudden storms from Africa bringing high amounts of abrupt rainfalls. The vegetation is adapted to these arid conditions and consists of drought tolerante plant species, such as *Zygophyllum dumosum, Haloxylon articulatum, Anabasis articulata, Anabasis syriaca, Astragalus spinosus, Suaeda palaestina, Salsola tetrandra, S. asphaltica, and Achillea fragrantissima.*

Flora is typically spread out on slopes or depressions, depending on water availability. Along wadis also occur riparian species (*Tamarix sp., Phragmites sp., Salix sp., Nerium oleander*) (Soto-Berelov 2012, 4).

Sudano-Decadian

Sudano-Decadian zone is demarcated by the region along the Rift Valley from the Gulf of Aqaba northward along the Jordan valley to Deir ´Allal. The flora is influenced by the northern extent on tropical African vegetation; among the common species belong *Acacia spp., Ziziphus spina-christi, Balanites aegyptica, Moringa aptera, Ocradenus baccatus, Salvadora persica* and *Calotropis procera* (Soto-Berelov 2012, 4).

Saharo-Syndian[2]

The Saharo-Syndian phytogeographical zone is placed in the Saharo-Syndian subregion, consisting of the eastward continuation of the Sahara from Cyrenaica to the southern Iraq (Zohary 1952, 208). The precipitation rate rarely exceeds 200 mm. soils mostly comprising of desert soils: haline hammadas, automorphous and hydromorphous salines and sand dunes. Most common floristic genera are Zilla, Retama, Anastatica, Citrullus, Reboudia, Gymnarrhena, Lasiopogon (Zohary 1952, 210.)

Northern Levant:

The area of northern Levant comprises of present western and southern Syria and Lebanon. Geographically it includes territories between the eastern Mediterranean Sea and the Syrian desert and the areas from the Taurus mountains to the Lebanon-Israel border.

Climatically, the northern Levant lies at the transition between the Mediterranean climate and the subtropical desert. The main source of precipitation is secure by eastern Mediterranean cyclogenesis, linked to the North Atlantic system, and controlled by the strength and position of the low-level Cyprus Low. Most of the moisture from the sea is intercept by the mountain range running parallel to the seashore; the highest point of the ranges, Mount Lebanon (3088 m asl) receives mean annual precipitation of >1,800 mm, primarily as snow at altitudes > 2,000 m asl. The annual rainfall decreases sharply, in

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[2] SA-SY zone is not part of Soto-Berelov classification

connection with the rain shadow of these mountains eastward. The rate of the decrease down to < 200 mm northeast of the Beqaa Valley (Gasse et al 2017, 173).

The northern Levant belongs to the Mediterranean and Iranio-Turanian phytogeographic region (Goring-Morris et al 2009) and the vegetation is made up of forest and woodland to open steppe. There is a visible transition from Mediterranean to montane, subalpine vegetation zones (Gasse et al 2017, 173). Attributes of the Mediterranean and Iranio-Turanian phytogeographic zones are identical to the zones describe within the southern Levant above.

2.2.2 THE DEVELOPMENT OF CLIMATE CONDITIONS IN THE LEVANT FROM LATE PLEISTOCENE TO EARLY HOLOCENE

The area of both south and the north Levant provides detailed and various range of paleoenvironmental records which enable the more or less complex picture of climatic condition development. The key period I focus on is the late Pleistocene to early Holocene.

Heinrich event 2, H2 (ca 23.8 cal ka BP; Robinson et al 2006)

Heinrich events are phenomenon manifested by rapid stadial cooling caused by large influxes of icebergs from the Laurentide ice sheet into the North Atlantic (Bigg – Wadley, 2001, 565). This cooling manifested in the Levant and the eastern Mediterranean by a sharp lowering in lake levels and a small positive deflection in speleothem oxygen isotope values, monitored in Soreq cave (central Israel) speleothem samples (Robinson et al 2006, 1533).

Last Glacial Maximum (23–19 cal ka BP; Robinson et al 2006); (25–18 cal ka BP Maher et al 2011)

In general, during the last glacial maximum (LGM) the Levantine territories were characterized by cooler and more arid conditions than the present, reaching its peak at ca 22 cal ka BP (Maher et al 2011, 6). A decrease in temperatures was detected in Soreq cave (central Israel); on the basis of the gradual increase in δ^{18}O the reconstruction of climate shows the air temperature ranging of ca 8–12 °C and mean annual rainfall 250–400 mm (presently 500 mm per yr). Dryer and colder conditions are observable also in the Negev desert in the form of erosion and precipitation of gypsum in the Dead Sea (Robinson et al 2006, 1533). In the pollen samples the dry and cold course of LGM was recorded in elevated non-arboreal pollen values in Ghab Valley (Syria) (revised Ghab stratigraphy in Rossignol-Strick 1995; Robinson et al 2006, 1533) and in the proportion of C4 plants typical for colder and drier conditions (Bar-Matthews et al 1999). The overall drying trend of LGM across the Levant support also environmental records at the Yammoûneh basin in Lebanon. The data show the development of steppic-desertic vegetation around the basin (Gasse et al 2017, 176).

Heinrich event 1, H1 (16.0 cal ka BP; Robinson et al 2006) (16.8–16.5 cal ka BP; Maher et al 2011)

Similarly, as H2, rapid-cooling in Heinrich event 1 (H1) is marked by a lowering of lake levels (Bartov et al 2003) and a small positive oxygen-isotope deflection recorded in Soreq cave (central Israel) (Bar-Matthews et al 1999). At ca 16.0 cal ka BP a sharp drop in SST (sea surface temperature) and a small decrease in salinity appear which might be a response to atmospheric cooling during H1 (Robinson et al 2006, 1535). H1 was caused by an abrupt influx of large volumes of fresh water into the Atlantic Ocean due to the penetrating of northern hemisphere icebergs into the ocean (Maher et al 2011, 7).

Bölling-Allerød warm interval (ca 15–13 ka; Robinson et al 2006)

The interstadial period of Bölling-Allerød is characterized by a rapid-warming, caused by the melting of Antarctic ice sheets in an event called Meltwater Pulse IA (Maher et al 2011, 7). The incoming warm period was manifested by the raising of lake levels connected with increased precipitation/evaporation ratio. Another important indicator of Bölling-Allerød climatic conditions are pollen records from Ghab valley: based on the revised pollen diagram (Rossignol-Strick 1995), oak forests and *Pistacia* were probably prevalent. Deciduous oaks require wetter conditions with at least 500 mm/yr rainfall. Such conditions correspond with Soreq cave speleothems records ranging 550-750 mm/yr (Bar-Matthews et al 1997, Tab. 2). In general, an increase in C3 plant type is observable (Robinson et al 2006, 1536). The shift towards the wetter and warmer phase is also well-documented in marine records, evidencing the rise of global temperatures of ca 4–5 °C, together with atmospheric CO_2 concentrations (from 200 ppm to 280 ppm).

According to some regional climatic records, there was a short period of *Older Dryas* between Bölling and Allerød warm phases, characterized by a brief return to cool and dry glacial conditions. The dating range between ca 14.5–13.7 ka cal BP, however, it is less dependable than most of the other climatic events. Due to its relatively short duration, it probably did not affect distinctively the eastern Mediterranean region (Maher et al 2011, 7).

<u>Younger Dryas (ca 12.7–11.5 ka BP; Robinson et al 2006)</u>

In paleoenvironmental records, the Younger Dryas is characterized as an extremely arid and cold period following the Bölling-Allerød warm interstadial. The change is the most significantly evidenced by the sedimentary record in the form of massive salt deposition and a lowering of lake levels in lake Lisan (Yechieli et al 1993) and the deposition of windblown sediments on the Israel coastal plain (Robinson et al 2006, 1536). There has been some debate about the course of climatic conditions during Younger Dryas due to poorly dated palynological records (Robinson et al 2006, 1536; Baruch – Bottema 1991, 1999), however the abundant occurrence of *Chenopodiaceae* and *Artemisia* indicate the mean annual rainfall of <150 mm/yr, plants associate with saline soils, arid conditions and areas with less than 100 mm mean annual rainfall. An increased presence of C4 plant type is evidenced also by speleothems record (Robinson et al 1536).

The debate about the Younger Dryas palynological record consists of variance of assessment of Ghab Valley (Syria) and Hula basin (northern Israel) samples; according to Bottema 1995 and Baruch and Bottema 1991 two climatic subregions existed during Younger Dryas, unlike the present-day uniform climate regime (Robinson et al 1524). The original age models for Ghab valley and Hula basin suggested increased forest cover and humidity in Syria (based on arboreal pollen values) while depletion of forests and increasing aridity in northern Israel. On the contrary, Rossignol-Strick (1995) took the models for both Ghab valley and Hula basin as non-credible, in comparison with palynological data from marine cores in the Mediterranean and the Western Arabian Sea and by the combination of oxygen-isotope stratigraphy, radiocarbon dating, and palynology a presence of above mentioned Chenopodiaceae across the entire Levantine and Arabian area (Rossignol-Strick 1995; Robinson et al 2006, 1524). According to revised chronology, similar dry and cold conditions during Younger Dryas are suggested both in northern and southern Levant. The drying trend of Younger Dryas in the north evidence also amounts of dry/saline Chenopodiaceae at Aammiq marsh (Gasse et al 2017, 176).

Younger Dryas represents a relatively distinct climatic phenomenon, yet there is a question of a real influence on the population, especially on the Near East. According to the recent data, the global temperatures decrease was "only" 0,6 °C, compared to Bölling-Allerød, such a cooling represented a perceptible but not a fundamental worsening of climatic conditions. The influence on the fauna, flora, or human populations was definitely not fatal, especially not in the Near East (Beneš 2018, 82).

The early Holocene (ca 9.5–7 cal ka BP; Robinson et al 2006)

The early Holocene is considered as the wettest phase across most of the Levantine territories and eastern Mediterranean. The most distinctive feature is the elevated annual precipitation evidenced by several factors: the increased occurrence of *Pistacia* and oak in Ghab valley and Hula basin pollen records (Rossignol-Strick 1995), the southward migration of the Negev desert boundary (Goodfriend 1999), and the existence of meandering streams in southern Jordan (McLaren et al 2004).

The increased rate of precipitation also supports the deposition of "red hamra" type palaeosols on the Israeli coastal plain (Gvirtzman and Wieder 2001). Lake levels got high; the estimated rainfall amounts range between 550 and 700 mm/yr (Bar-Matthews et al 2003; Robinson et al, 1536). The increased humidity is witnessed by more frequented C3 plants: their occurrence is suggested according to relatively negative speleothem δ^{13}C record from the Jerusalem Cave (Frumkin et al 200). Within the early Holocene, Rossignol-Strick (1995) distinguishes also a regional „Pistacia phase", at 10.2 –6.7 cal ka BP, suggesting mild winter and mean annual precipitation between 300 and 500 mm (Robinson et al 2006, 1524). The estimated terrestrial palaeotemperature was ca 16 °C, according to McGarry et al (2004) (Robinson et a 2006, 1537).

Depositing of sediments rich in organic carbon (= Sapropel 1, S1) is characteristic for the period of early Holocene (ca 9.5–7 cal ka BP) (Robinson et al 2006, 1537; Emeis et al 2000).

Noticeable short-time scale climatic change within early Holocene was the so-called *8.2 cal ka BP event*; this abrupt cooling event was set off by the glacial drainage of fresh water into the North Alantic. The overall characterization of this event perceptible in multiple proxy records (e. g. Greenland ice core), is in general dry and cold. These conditions lasted ca 160 years (Roffet-Salque et al 2018). The most affected was the area of North Atlantic, by the decrease of average annual temperatures ca 5°C and rise of seas levels and oceanic circulation changes, caused by a large influx of freshwater (Maher et al 2011, 8). Evidences for the occurrence of the abrupt climatic event at Near East at 8.2 are scarce except for geochemical, isotopic, and pollen records from several lakes in Anatolia (Roffet-Salque et al 2018). However, they indicate dropping the temperatures ca 1°C. The 8.2 ka event is also probably related to the deposition of gypsum and sands indicating low water levels of 416 m below sea level for the Dead Sea (Maher et al 2011, 8).

In general, the development of a climate in the northern and southern Levant from late Pleistocene and during Holocene might be characterized as an alternation of cold/dry and warm/wet phases, with several distinctive climatic peaks which strongly influencing local environmental conditions, i. e. Heinrich events, Younger Dryas or Bölling-Allerød. Except for some small local deviation, the climatic trends within larger events_were basically identical in both the north and south Levant.

event	**dating** (Maher et al 2011)	**climatic conditions**
Last glacial Maximum (LGM)	25–18 ca ka BP	cold/dry
Heinrich event 1	16.8–16.5 cal ka BP	rapid cooling
Bölling-Allerød	ca 15–13 ka BP (Robinson et al 2006)	rapid warming
Younger Dryas	ca 12.7–11.5 ka BP (Robinson et al 2006	rapid cooling/dry
Preboreal	11.4–ca 9000 ka BP	rapid warm/wetter

Tab. 3: Summary of the palaeoclimate events of the late Pleistocene (Robinson et al 2006; Maher et al 2011)

2.2.3 CLIMATE AND CULTURAL CHANGES: ENVIRONMENTAL DETERMINISM IN THE LEVANT

Environmental determinism is closely connected with the principles of processual archaeology, in the present day manifested by the resurgence of paleo-environmental studies (Arponen et al 2019). However, the correlation of environmental or climatic changes with the cultural and social changes related to the Neolithic period appears in the form of different approaches throughout the history of research. To demonstrate variability of this approach, a summary of the most distinct theories, concerning the influences of climatic changes on the shifts in culture and society, is present below (following the summary by Maher et al 2011).

As stated above, the social and cultural changes at the turn of the late Pleistocene and early Holocene were examined by environmental aspects repeatedly and plentifully. One of the first was V. G. Childe (1928), proposing a climatic explanation for the origins of agriculture by his "oasis theory", about the relation of climate change at the end of the Pleistocene and the origins of food production. Despite criticism by e. g. Braidwood (1951) and others, and the shift from the cultural-history paradigm in general, the environmental explanation of individual phenomenon persists in the course of the subsequent evolution of research and paradigms.

During 60´s L. Binford came up with the concept of the beginning of food production (Binford 1968) with the population movements playing a key role. The increased pressure on food recourses together with climate changes supposed to cause rising sea levels at the end of the Pleistocene and therefore the dependence on aquatic sources and increased sedentism and population growth. The subsequent population pressure on resources in the less-optimal zones was perceived by Binford as a trigger of intensifying subsistence technologies (Maher et al 2011, 4-5). Concerning the early Neolithic, recently Binford (2001) emphasizes the climate stress of Younger Dryas as a mover of higher mobility in late Natufian and that ´a return to maximum mobility and extensive egocentric networks´ (Binford 2001, 454) followed the Younger Dryas and that the social networks probably failed during the PPNA (Maher et al 2011, 5).

To the climate stress in Younger Dryas pointed out also many others: Bar-Yosef (Bar-Yosef 1982; 1996), suggesting that the transition from hunter-gatherers to agriculture arose from late Natufian needs, caused by worsen climate and resource stress during the Younger Dryas (Maher et al 2011, 5). Similarly, Moore and Hillman (1992) and Rossignol-Strick (1999) observe the same connection of extreme aridity during the Younger Dryas and the emergence of the Neolithic subsistence system (Maher et al 2011, 5).

On the other hand, although F. Byrd (2005, 245) connects the late Natufian with the Younger Dryas in the southern Levant and places the onset of stable settlement of PPNA societies into the Preboreal phase with increased temperatures and precipitation, he does not see the environmental stress as a key factor causing the subsistence changes. On the contrary, he emphasizes the ideological and social impulses during favourable climatic conditions (Maher et al 2011, 5). Also, McCorriston and Hole (1991) expressed their doubts about the simple environmental causes as triggers of such a radical subsistence change and transformation into an agricultural society. They see the beginning of Neolithic as a conjunction of several both environmental and social factors, together with ideological and technological preconditions (Maher et al 2011, 5).

For describing how and if are these approaches reflected in my thesis, a definition of my supposition and thesis aim are needed. The idea of examining the possible influence of different environmental conditions on the change of ground plan is based on two assumptions: a very broad range of ecological zones and variability within the observed area of Levant, and a relatively short chronological period of the performance of the change.

What should be emphasized though, is that the architectural change will not be examined from a perspective neither of a long-term, nor abrupt climatic change. My examination focuses on the relatively short chronological range from LPPNA to MPPNB, moreover, the chosen range lies in a relatively stable climatic period of an early Holocene, placed between the end of Younger Dryas and 8.2 ka event. The chronologically closest climatic event of 8.2 is connected to the very end of PPNB period and so is not relevant for my topic.

Therefore, the aiming of this thesis is then an examination of the question about the environmental and architectural mutual dependence within a relatively stable climate. Into this question, a local environmental difference within a stable climate will be projected: the thesis is not dealing with the abrupt, or strong climatic events, but with the constant effect of a variable condition.

According to Willcox, “the shift to settled village farming in the Levant now appears, however, to have been a lengthy and regionally variable process“ (Willcox 2007, 32). While the development of settled villages in Natufian or PPNA in a period of climatic instability, the farming and village life establishment was happening during the stable Preboreal conditions (Maher et al 2011, 21).

By this definition, the change of buildings shape, being the part of the “village life” establishing, will be examined as a regional adaptation to the climatic and environmental stability.

2.3 CURRENT ARCHAEOLOGICAL PERSPECTIVE OF EPIPALAEOLITHIC AND EARLY NEOLITHIC COMMUNITIES AND THEIR RELATIONSHIP TO HOUSEHOLDS AND ENVIRONMENT

The aim of this chapter is to provide a deeper insight into the development of late Epipalaeolithic and Neolithic architecture and present the categorization the Neolithic architecture by individual scholars. The main issues dealt with within the problematics of early Neolithic architecture will be also examined below. This broad topic, consisting of settlements and individual structures development, the shift from circular to rectangular houses, or change of spatial organization within a settlement, represents a frequent bunch of questions within the Near East Neolithic and has been often and plentifully discussed by many others (e. g. Banning – Byrd 1989; Byrd 1994; Flannery 1972, 2002; Goring-Morris – Belfer-Cohen 2008, 2013; Białowarczuk 2016). Therefore, my intention is to describe a summary of present approaches of Neolithic architecture topic which provides a necessary framework for my own work.

2.3.1 TYPOLOGIES OF EPIPALAEOLITHIC AND NEOLITHIC STRUCTURES

Two main construction types are distinguishable within a Neolithic architecture: the round and rectangular ground plan. However, the growing number of detected sites enables more detailed categorization, including the definition of the transitional type on the boundary of round/oval and rectangular buildings. This transition was detected for the first time at the site Beidha in Jordan (Byrd 2005).

A relatively detailed summary of individual categories was elaborated by M. Białowarczuk (2016). This model is applicable for the whole Levantine area and represent the most general categorization of the earliest structural forms. Considering more detailed classification, in my database, I frequently follow also types of ground plane defined by D. Stordeur (2015) from the site Jerf el-Ahmar. However, the classification is almost exclusively restricted to the northern Levantine architecture.

General categorization (Białowarczuk 2016):

Circle structures

Circle structures represent the oldest and the most basic type of building, used by the early and middle Epipalaeolithic communities (Białowarczuk 2016, 576–579).

The smallest structures range from about 1,2–2 m in diameter, as at Çayönü Tepeşi (Özdoğan 1999), while the largest reach 6–7,5 m, as at Nemrik 9 (Białowarczuk 2016, 579).

In the northern Levantine area larger structures appear, with diameters of about 10–12 m (e. g. Tell Qaramel and so-called ´public houses´) (Mazurowski and Yartah 2002). The growth in size was usually paralleled by the internal division of houses into multi-roomed structures (Białowarczuk 2016, 579).

Two variants of the evolution of rounded buildings are presumed: the first one represents a simple transformation from primitive shelters into open, free-standing forms, the second one describes shelters converted into large round subterranean houses (Białowarczuk 2016, 585).

Oval structures

Together with round buildings, oval structures belong to the oldest and most simple types. They differ regionally in size: the smallest are characteristic for settlements of the northern and central Levant (e.g. Tell Qaramel, Jerf el-Ahmar and Tell Aswad), while the largest diversification in size is typical for the southern Levant and northern Mesopotamia. The average size of oval buildings reaches 2,8 m by 3 m. Splitting into multi-roomed units was detect in some cases of oval structures (apart from northern Mesopotamia, where oval houses remained monocellular during the whole PPNA) (Kozlowski 1998). For the oval houses, full and semi-open plans are characteristic (Białowarczuk 2016, 579–580).

Agglutinative structures

Agglutinative type is characterized by an irregular plan consisting of two or more separate extensions, connected into one multi-roomed unit. The irregularity of agglutinative ground plan is what distinguished this type from other multi-roomed forms.

The structures are mostly single-spatial, furnished with one to three smaller extra extensions (round, semi-round, semi-oval). The size of agglutinative structures differs from 3 m to 5, by 7 m, including the extensions.

Distribution of this type of house is limited to very few sites (e. g. Tell Qaramel, Jerf el-Ahmar). The development of agglutinative structures is presumably related to a micro-regional scale. These buildings have an exceptional position in the northern Levant where the agglutinative forms might be taken as a transitional form between round and subrectangular ground plan[3] (Białowarczuk 2016, 580). (Fig. 5)

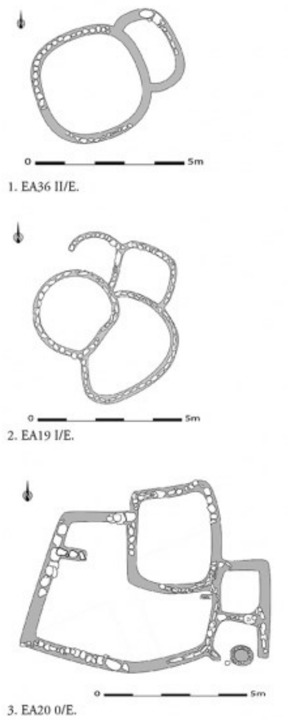

Fig. 5: Types of agglutinative structures (Stordeur 2015, Fig. 46)

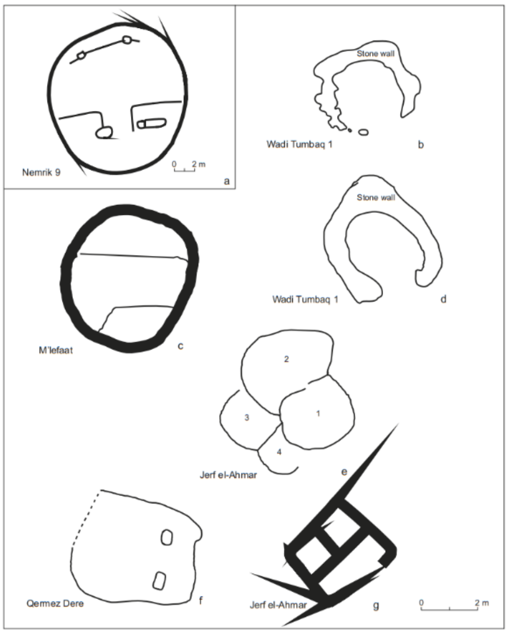

Fig. 6: Types of ground plans: a – round full; b – round semi-opened; c – oval full; d – oval semi-opened; e – typical agglutinative; f – subrectangular; g - rectangular (Bialowarczuk 2016, Fig. 1)

[3] Closer examined in the PPNB architecture section

Subrectangular structures

Besides the agglutinative structures mentioned above, subrectangular buildings are other representatives of the transitional ground plan. The earliest evidence belongs to middle phase of PPNA; horizon H3 of Tell Qaramel, dated to 9820–8710 BC (Mazurowski et al. 2009) and phase IIIB at Tell Mureybet (Bar-Yosef 2008, 131). In the southern Levant, this type appears in the final phase of PPNA (e. g. Netiv Hagdud, Gilgal I) (Stordeur 2015).

Straight external walls with rounded corners are typical for this type. Their size ranges from 2,5 m by 3 m as the smallest in northern Levant to 6 m by 7 m as the largest in northern Mesopotamia. In the case of southern Levant, more diversified architectural dimensions are characteristic (Białowarczuk 2016, 581).

Rectangular structures

The basic characterization of this ground plan is its perfect rectangularity with right-angled corners (Białowarczuk 2016, 581). The commencement of rectangular type is considered as corresponding with the transition phase of EPPNB at the turn of 10/9th millennium BC (Edwards 2016) and the earliest forms of rectangular houses are associated with the area of northern Levant.

Based on the findings in Levant and Anatolia, several types of rectangular buildings might be distinguished (´grill house´, ´pier house´, ´courtyard´ house, ´pueblo style´ houses).

Such a substantial change in the ground plan was reflected in the strong diversification of interior space. Its division formed multi-roomed units and brought a fundamental transformation of the house interior.

The size of rectangular houses varies from 3,5 m to 12 m or more, depending on the total number of rooms (Białowarczuk, 581–582).

2.3.2 EPIPALAEOLITHIC ARCHITECTURE

Early (eEPP) and Middle Epipalaeolithic (mEPP)

For early (ca. 21,000–15,500 cal BC) and middle Epipalaeolithic (ca. 15,500–13,000 cal BC) open-air sites constituted by huts and related architectural features are typical (Goring-Morris – Belfer-Cohen 2008). The building´s shape was mostly flimsy, kidney-shaped or sub-oval, 3-5 in diameter, interior floor spaces not surpassing 12 m^2. Huts were generally semi-subterranean, ca. 20-40 cm deep, bowl-shaped in profile. The construction consisted of the branches of locally available trees and bushes, pitched in a wigwam or arched configuration. Also, the remains of post-holes already appeared, namely at Jiita rock shelter (Melki 2004).

Evidence of internal hearths are rare, waste debris feature occurred both within and outside the building. To interior features belong bedding and workslabs while stone installations (such as cobble platforms or small paved areas) are commonly located outside the structures. One of these paved areas was interpreted as a baking oven in Ohalo II (Nadel 2006).

Late Epipalaeolithic (lEPP)

Late Epipalaeolithic is infilled by the Natufian cultural complex: a more sedentary lifestyle and solid settlements functioning within hunter society are typical for Natufian population. Solid structures appeared mostly in the Mediterranean zone and from peripheral arid areas of the Negev desert, also, dated to late Natufian (Goring-Morris – Belfer-Cohen 2008, 250). The size of Natufian settlements varied in time, ranges from 1000 to 2000 m^2, however sometimes reaching up to 5000 $m^{2.}$ (Barker 2006, 118).

Early Natufian (ca. 13 000–11 000 cal BC) settlements consisted of large (ca 7–15 m diameter) circular or D-shaped structures, spatially segregated. The sophisticated roofing is evidenced by a circular internal arrangement of post-holes (Goring-Morris – Belfer-Cohen 2008, 244) with single or sometimes double rings of supports (e. g. Wadi Hammeh 27). Besides the larger buildings also smaller structures appeared, mostly 1,5–

2,5 m in diameter. Their function might be different from solely habitable (e. g. Hayonim cave).

Considering the frequent placement of burials under the floors, they might be taken as a part of the interior. Early Natufian burials commonly either pre-, or postdate the daily use of these internal features. Some graves were found at spatially segregated places, sometimes also placed within a distinctive funerary architecture (e. g. structure with a plastered bench at ´Habitation 1´at Eynan) (Goring-Morris – Belfer-Cohen 2008, 250).

Late Natufian (ca. 11 000–9 600 cal BC) architecture evinces the tendencies of reducing the size of individual domestic structures; they are oval or D-shaped and their size does not exceed 10 m^2 of internal floor space (e. g. Eynan). The roof was supported by one or two pillars given the evidence of post-holes. In general, late Natufian architecture shows a more opportunistic approach to architectural planning and building. Inner features of structures consisted of hearths which were located along the axis of the structure and of so-called ´basins´, which are described as a slightly depressed surfaces consisting of numerous small stones, externally adjacent to structure walls. Finally, the graves constitute an important component of internal space (Goring-Morris – Belfer-Cohen 2008, 250).

Late Epipalaeolithic settlements also appeared in the Negev area, namely in the territory of Negev highlands and lower elevation. A highland Rosh Horesha-Saflulim site complex is significant: the site is as ca. 4000–5000 m^2 large and likely represented a regional aggregation; similarity to those of the early and middle Epipalaeolithic in easter Transjordan is apparent. The character of scarce remains of structures is represented by a large kidney-shaped building, 8 m in diameter, constructed of massive slabs. However, this structure is not taken as a domestic one (Goring-Morris – Belfer-Cohen 2008, 250).

In Negev highlands also later Harifian base camps are found: Harifian architecture is standardized with spatially segregated units, consisted of single, semi-subterranean dwellings, each 3–4 m in diameter. These structures commonly contained interior features such as bedrock mortars and large grinding slabs. Smaller constructions, 1–2 m in diameter, served probably as storage constructions (Goring-Morris 2008, 250–251).

In lower elevations, a ´beehive´ type arrangement of the small, clustered structure appeared. Related to the site at Rosh Zin, structures were stone-built, ca. 3–5 m diameter (Henry 1976). Individual buildings are considered to belong to nuclear families. One unusual Rosh Zin structure includes also a unique interior monolithic pillar, interpreted as symbolic (Goring-Morris 2008, 250).

2.3.3 NEOLITHIC ARCHITECTURE

The outset of the Neolithic is besides others generally related to the changes in settlement structure, both in the arrangement of internal space and the settlement layout. However, the fact that the early Neolithic architecture follows the Epipalaeolithic model in some respect should be highlighted. There is a clear continuity in the building tradition of Natufian round plan houses within the entire PPNA architecture: in the sense of ground plan, the transition from circular PPNA to PPNB rectangular model represents a more distinctive difference than the change from Natufian to early Neolithic. When discussing the evolution of the Neolithic architecture in the Levant, it is also necessary to perceive a slightly different development of building traditions in northern and southern Levant, both in PPNA and PPNB. Because of these differences, the development of Neolithic architecture in northern and southern Levantine will be described separately.

<u>PPNA</u>

In general, the PPNA settlements consist of various types: short-time seasonal camps (e. g. Iraq ed-Dubb), smaller hamlets (Wadi Feynan 16, Dhra´, Nahal Oren), and small-scale ´villages´, up to 2,5 ha (Jericho, Gilgal, and Netiv Hagdud). All types of sites were located along the southern rift valley, at intervals of 15–20 km (Goring-Morris – Belfer-Cohen 2008, 254).

Key factors by which PPNA populations chose their place of residence are proximity to a water source and the existence of alluvial soils (Naveh 2003, 88).

The major change resides in the occasional constructing of monumental communal architecture within the settlement. The very best example of such activities is represented by Jericho and its wall, ditch, and tower (Goring-Morris – Belfer-Cohen 2008, 254; Naveh 2003).

Southern Levant:

The settlement pattern concentrated mostly on the lowlands, mainly in the Rift valley (at intervals 20–25 km) and along the western flanks of central hills. On the contrary, almost no occupation is detected in arid areas (Goring-Morris – Belfer-Cohen 2013, 22). The residential PPNA architecture in the southern Levant followed the Natufian model of relatively small-scale settlements and semi-subterranean oval structures of various sizes (up to 7–9 m diameter), which indicates the occupation by the nuclear family (Goring-Morris – Belfer-Cohen 2008, 254). However, few sites in the Rift valley can be described as real villages in terms of the total extent or according to the presence of communal structures for example at Netiv Hagdud or already mentioned Jericho (Goring-Morris – Belfer-Cohen 2008, 274).

Concerning the construction, stones used for foundations and puddled mud wattle together with daub belonged among the frequent materials. Using mudbricks representing the innovating element.

Bases were mostly cobbled or made up from beaten earth. The characteristic interior features constitute raised platforms on notched slabs (e. g. at Dhra´), occasional dividing walls, and hearths. Trash was usually disposed of in external areas or abandoned structures, in close distance to domestic dwellings, though. Outside the building also external silos occurred (Goring-Morris – Belfer-Cohen 2008, 254).

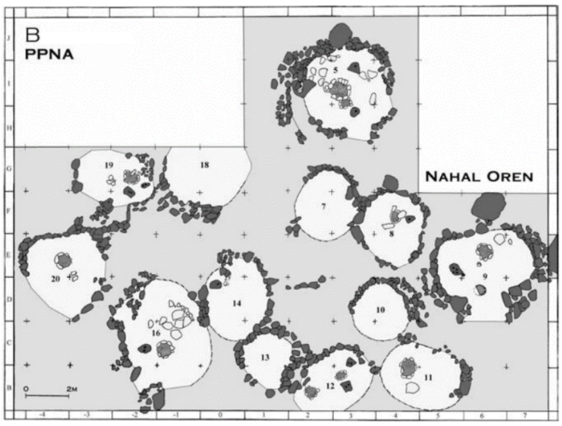

Fig. 7: PPNA settlement plan (Goring-Morris – Belfer-Cohen 2008, Fig. 16)

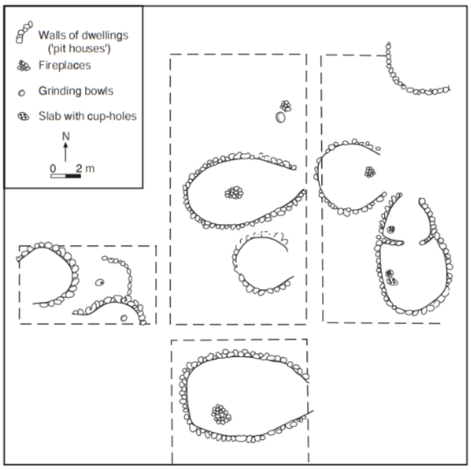

Fig. 8: Plan of PPNA settlement, Netiv Hagdud (Barker 2006, Fig. 4.10)

Northern Levant:

The situation in northern Levantine territories slightly differs from the architectural traditions in southern and central areas, especially during the later stages of PPNA (Goring-Morris – Belfer-Cohen 2013, 24).

The early PPNA architecture followed the Natufian pattern as well: houses were rounded, constructed at first as subterranean and later directly on the surface, with floors covered by slabs or pebbles. According to archaeological findings at the Mureybet site, buildings foundations were constructed of the line of stones, with walls made of adobe, sometimes reinforced with stones. Underground constructions were supported by wooden posts coated with clay (Bar-Yosef 2008, 130).

Later stages of PPNA were characterized by the type of settlement derived from different non-Natufian background, consisted of small villages with semisubterranean community "kiva-like" structures, probably serving extended families. Examples of these structures occur on sites at Jerf el-Ahmar, Mureybet, Nemrik, or Qermez Dere. Such a type of special structures can be considered as a herald of later PPNB architectural units or ritual sites in southeastern Anatolia (e. g. Nevali Çori and Çayönü or Göbekli Tepe) (Goring-Morris – Belfer-Cohen 2008, 275).

In general, the northern Levantine sites are considered as a bearer of smooth late PPNA/early PPNB transition from circular and oval ground plans to the rectilinear structures (Goring-Morris – Belfer-Cohen 2008, 257), witnessed by Tell Mureybet or Jerf el-Ahmar site. However, this issue is tightly connected to the problem of presence and expansion of the early phase of PPNB (EPPNB) without a clear conclusion and will be closer examined below.

PPNB

The commencement of PPNB relates to the onset of constructing rectilinear structures and therefore represents a key period for my thesis. The new shape of buildings together with the considerable enlargement of settlements represent the most significant architectural changes of PPNB and are relevant for both northern and southern Levantine territories.

According to the already mentioned problematic issue of transitional early stages of PPNB, which is closely examined in the individual chapter about PPNB period, both regions will be described separately, just as PPNA.

However, few general factors common to the whole Levant should be mentioned: the size of most PPNB sites ranges between 2–12 hectares, with a population of approximately 1000–2000 people in the case of larger tells. The new characteristic in the PPNB settlement composition consists of the rectangular ground plan, often with stone foundations and walls made either of *tauf* or *pisé* (= mud on a withy frame, baked in the sun) or mudbricks. Most of the settlements are situated in low-lying locations with a good water supply and near moisture-retentive alluvial soils (Barker 2006, 137–139).

Southern Levant:

In general, the course of PPNB architecture´s shape development is oriented from the oval/transitional to purely rectangular ground plans. At the later stages of PPNB, the villages were mostly based on quadrilateral multicellular units (Goring-Morris – Belfer-Cohen 2008 261).

Structures were mostly constructed by a combination of mudbrick walls with stone foundations. Somewhere a regional difference is observable, such as dressed stone masonry, characteristic for southern Jordan. Also, another construction element appeared, such as stone-built channels under some structures, providing the most probable drainage, e. g. es-Sifiya or Basta (Goring-Morris – Belfer-Cohen 2013, 26).

For floors and walls construction mostly lime plaster was used. For the massive use of this material, lime-plaster floors are considered a hallmark of PPNB in the southern

Levant (Goring-Morris – Belfer-Cohen 2008, 261). Large stony surfaces served probably as a stabilizer of muddy open areas where herds were corralled.

Rubbish was commonly thrown into abandoned structures or open areas (the ´courtyards´), forming extensive midden deposits (Goring-Morris – Belfer-Cohen 2013, 28).

Four basic plans for central and southern Levant belonging to the later phases of PPNB (late MPPNB/LPPNB) might be distinguished (Goring-Morris and Belfer-Cohen 2008):

a) The long-axis ´corridor´ house, pier-house, ´megaron´: two-storey, domestic activities concentrated in upper stories, semi-subterranean basement consisted of multiple cells, used for storage and workshop, e. g. Beidha (Fig. 9) or Jericho,

b) the enclosed ´courtyard´ house: upper floor used for domestic activities, ground floor consisted of small cells, entered through raised doors or windows, e. g. Basta (Fig. 10),

c) loose ´pueblo-style´ structures: two, or three storeys, constructed on steep slopes, e. g. Ba´ja,

d) enclosed single storey courtyard residential units*:* characteristic for the final PPNB and beginning of pottery Neolithic (PN), e. g. Shar Hagolan (Fig. 8).

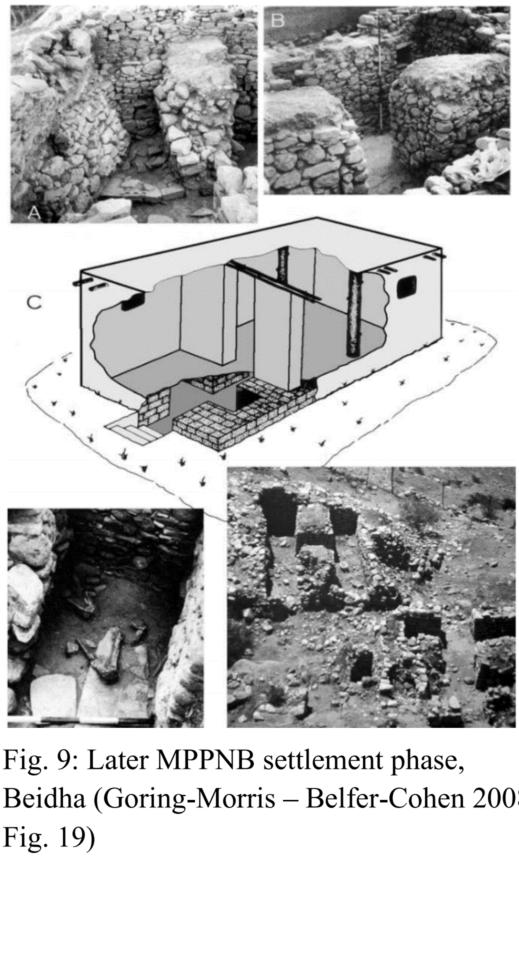

Fig. 9: Later MPPNB settlement phase, Beidha (Goring-Morris – Belfer-Cohen 2008, Fig. 19)

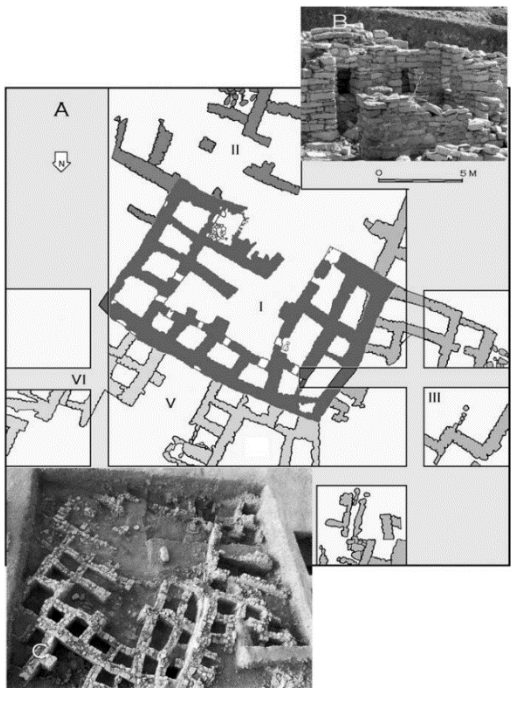

Fig. 10: Late PPNB settlement, Basta (Goring-Morris – Belfer-Cohen 2008, Fig. 20)

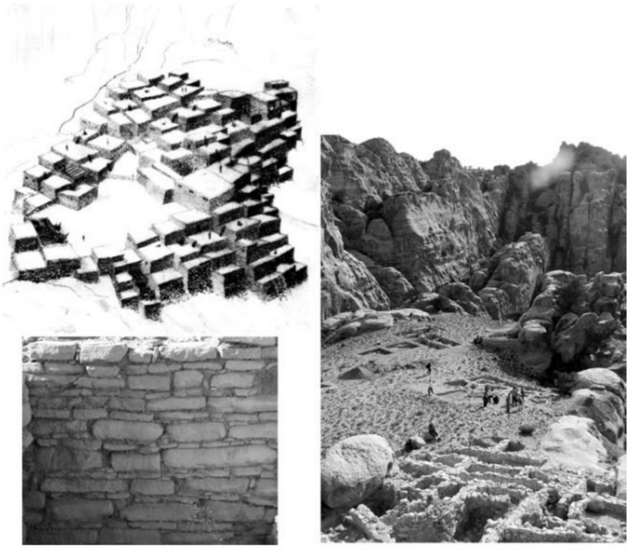

Fig. 11: Late PPNB settlement, Ba´ja (Goring-Morris – Belfer-Cohen 2008, Fig. 21)

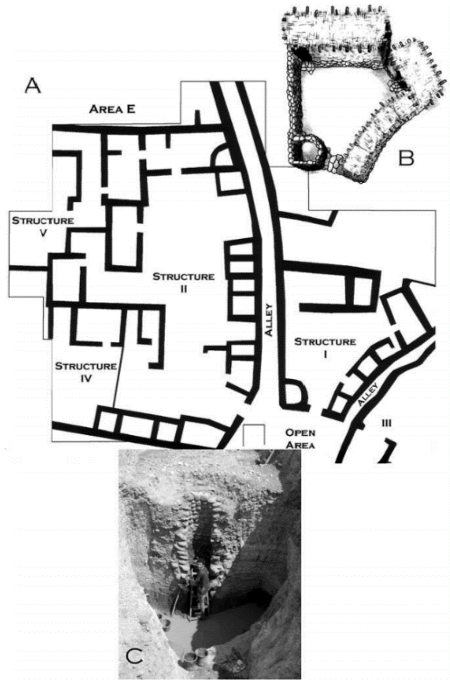

Fig. 12: Yarmukian Sha´ar Hagolan settlement (Goring-Morris – Belfer-Cohen 2008, Fig. 22)

At some sites, the existence of larger structures was detected. Some of them were interpreted as communal structures (e. g. Beidha: Byrd 1994), others are considered as probably sacred precincts with distinctive architecture in one part (e. g. ´Ain Ghazal, Atlit Yam, Jericho: Byrd 2005). What should be emphasized though, apparently none of these structures have served as burial places (perhaps except Jericho and Atlit Yam) (Goring-Morris – Belfer-Cohen 2013, 29).

The basic residential unit probably served the extended family while some family activities were probably performed as concealed from the wider community. Such a function might indicate for example long walls separating different areas of the site (Goring-Morris – Belfer-Cohen 2013, 28).

Dead were buried on-site, within the settlements: sometimes under house floors or within walls as foundations deposits or after house abandonments and in open areas too. However, in general, there is a lack of burial within settlements. The reason might consist in the existence of separate cemetery sites, following the Natufian traditions. An example of these “cemeteries” is provided site by Kfar HaHoresh (Goring-Morris 2005). The site is situated outlying from the villages in lowland, and it was used probably by its residents. It consists of a monumental, walled, and plastered podium and later funerary architecture with plastered surfaces and bounding walls, postholes, and monoliths, numerous burials. Besides, extensive midden deposits containing residues of feasting and other ceremonial activities (Goring-Morris 2013, 31).

Territories of a desert periphery of southern Levant were occupied by small mobile foraging groups, still seasonally occupying sites. The character of their settlements was waist-high circular stone-built huts and organic superstructures in ´beehive´ arrangements (Goring-Morris – Belfer-Cohen 2013, 31).

Northern Levant:

The most significant distinction of northern PPNB sites is the smoother transition from PPNA to PPNB. Thanks to this gradual shift, also early stages of PPNB quadrilateral architecture are captured at northern sites. The complicated issue of existence or non-existence of EPPNB in the southern Levant was described in detail in chapter above, nevertheless, the existence of this initial stage at the north can be stated undoubtedly. Spreading into eastern areas of central Anatolia accompanied the onset of PPNB in the northern Levant and the typology of PPNB architecture is often mentioned together with those from Anatolian territories (Goring-Morris – Belfer-Cohen 2013, 31).

The gradual transition from circle to rectangular house plan is witnessed by a diverse range of transitional types reflecting largely the early stages of PPNB. A categorization of these multicellular buildings was made by D. Stordeur at the site Jerf el-Ahmar:

a) tripartite multicellular (Les maisons pluricellulaires tripartites structurées en T), separated by walls in three spaces, the third one considered as a possible courtyard (Fig. 13),

b) multicellular house with rooms in the row (Maisons pluricellulaires à pièces en enfilade), transversely subdivided. Earliest two-roomed, more recent four-spaced. Mostly elliptical or curvilinear rectangle. (Fig. 14),

c) multicellular house with clumped rooms (Maisons pluricellulaires à pièces agglutinées.), shape resulted from addition of independent cells. Multi-lobed shape, uncertain sequence of building annexes or house itself. Identified solely at Jerf el-Ahmar (Fig. 16),

d) multicellular house with four crossed rooms (Maisons pluricellulaires à quatre pièces en croix.). Typical for PPNA/PPNB transition phase at Jerf el-Ahmar, strictly rectangular shape. Similar to the structures at Tell Mureybet (Fig. 15).

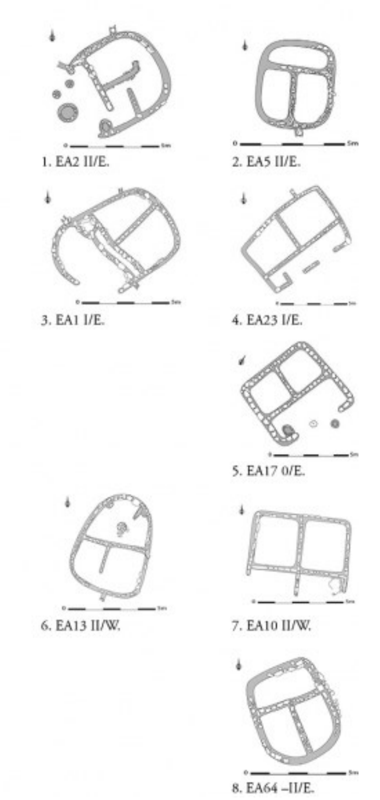

Fig. 13: Tripartite multicellular houses (Stordeur 2015, Fig. 43)

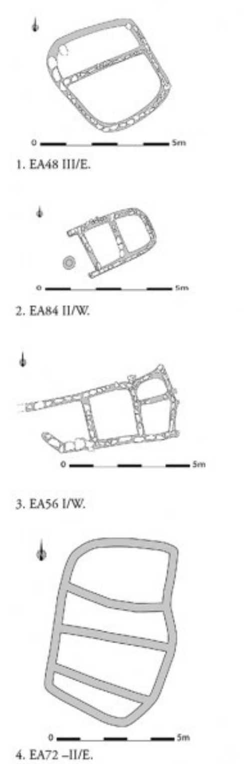

Fig. 14: Multicellular houses with the rooms in the row (Stordeur 2015, Fig. 44)

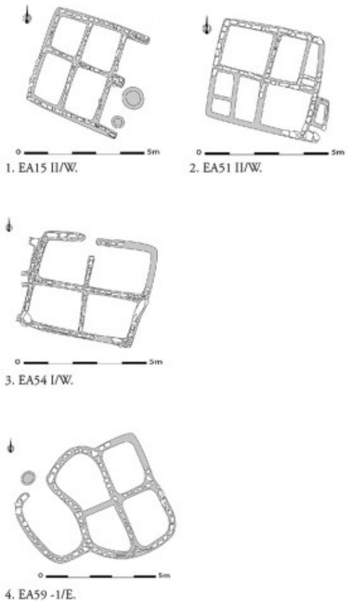

Fig. 15: multicelular houses with four crossed rooms (Stordeur 2015, Fig. 46)

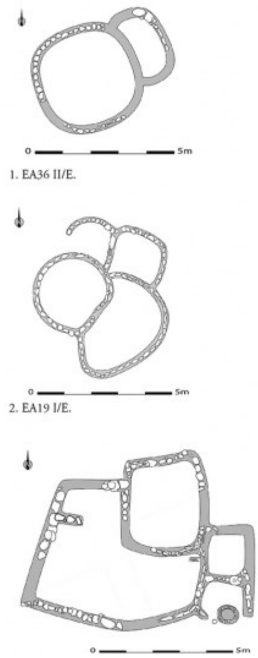

Fig. 16: multicellular house swith clumped rooms (Stordeur 2015, Fig. 45)

In later stages, northern Levantine and Anatolian residential structures were based on large quadrilateral structures. A typical form of such a dwelling was (in early stages) a ´long house´ built on raised ´grill´ foundations (e. g. Nevali Çori or Çayönü). The layout of the settlement indicates a planned construction, which is indicated by the systematic orientation of houses in some sites.

Foundations were mostly constructed of stone with mudbricks. The floors were raised, probably avoiding rising damp and roofs flat. On some sites, floors and walls were covered by gypsum plaster (Goring-Morris – Belfer-Cohen 2013, 31). Some sites consist of large open areas (´interpreted as ´plazas´ or probably sacred precincts) and residential quarters together with communal buildings (e. g. Çayönü or Asikli Hüyük).

Larger structures occur within some sites equally as in the southern Levant; however, their function might be related to burial purposes. By some, they are interpreted as charnel houses for the disposal of the dead (e. g. Çayönü). From Anatolia, some intentional burials of structures are known, possibly intended as closure events (Goring-Morris 2013, 31).

Concerning the burials, the situation is similar to the one in the south, when the number of excavated burials is too low to be representative of the actual population.

However, this condition might indicate that the normative burial customs were carried out off-site deposits. Nevertheless, some exceptions show intentional depositing bodies within the individual space of the settlement or household (e. g. Tell Hallula where burial pits were systematically located just inside the entrance of the houses: Guerrero et al. 2009).

The existence of sophisticated wells should be mentioned**,** which are known only from the final PPNB (e. g. Atlit Yam or Sha´ar Hagolan) (Goring-Morris – Belfer-Cohen 2013, 31).

Two another later PPNB architectural trends are observable in the Northern and southern Levantine territories. For the southern Levant, "*pier houses*" are typical. "Pier houses" (or ´megaron´, by Garstang 1935) are large rectangle structures with an entrance typically on one of the shorter sides. The roof is supported by stone or brick piers, wooden posts, or a combination of both, arranged symmetrically along the long axis of the rectangle. Sometimes the piers adjoin the long sidewalls while leaving only the central passage. Often there is also a gap between a pier and the sidewall which provides additional access from one part of the house to another. Each pier house was probably a self-contained unit, often separated by a narrow alley, in case of closely spaced houses (Banning – Byrd 1988, 65–66).

This type contrasts with the *larger multicellular buildings* typical especially for the PPNB settlements in the northern Levant (Banning – Byrd 1988, 70). Such a type is present for example at Tell Mureybet in the IVB phase, dated to the beginning of the MPPNB phase, consisting of long rectangular rooms with mud walls (Ibañez 2008, Tab. 1)

2.3.4 CHANGE OF THE GROUND PLAN: DIFFERENT APPROACHES

The main aim of my thesis is to examine the change of house plan in terms of a possible influence of environmental conditions. However, this change is a broadly discussed topic, especially from the architectural and social aspects. One approach enables to observe the progress of the ground plan change from the technical and construction point of view, another one discusses the possible social consequences and perceives the architectural change within a broader context of transformation the early Neolithic society[4].

Both approaches will be shortly introduced here to create a theoretical background to my own environmental research of the house-plan transition.

<u>“Construction” approach</u>

This approach permits observing the morphological and construction changes of the buildings. In detail, for example, M. Białowarczuk (2016) summarized the construction evolution.

The first initial step was the development of round houses in PPNA: emerging from the rounded or oval shelters, two variants of the creation are known.

a) a simple transformation from primitive shelters into open, free-standing durable forms,

b) the conversion of shelters into large subterranean houses (Białowarczuk 2016, 585).

[4] An important fact should be noted here, this category serves only for purposes of my thesis and for the clearer survey of this broad topic. This categorization is based only on my observation of the most frequented approaches.

In both cases, the main criterion of the development was the effort to enlarge the interior of the living space.

Concerning the subsequent round house evolution, in the first variant from shelters to free-standing forms, six stages are distinguishable (Białowarczuk 2016, 585).

Stage I: direct imitation of Epipaleolithic shelters,

Stage II: the appearance of a more permanent variant of semi-subterranean round house, together with lowering the floor level (e. g. Nemrik 9 or Tell Qaramel),

Stage III: modification of the semi-subterranean structures by the introduction of resistant walls inside dwelling pits,

Stage IV: introducing further improvements, especially the construction of higher walls. Also, modification of construction techniques relates to this stage,

Stage V: first free-standing structures on the ground level are built, with durable walls made by advanced techniques (e. g. stone or *pisé*). This form seems to be strictly connected with the evolution of construction techniques (for example increasing the durability of the walls).,

Stage VI: the appearance of free-standing houses built on ground level, walls made by uniform techniques (Białowarczuk 2016, 58–-587).

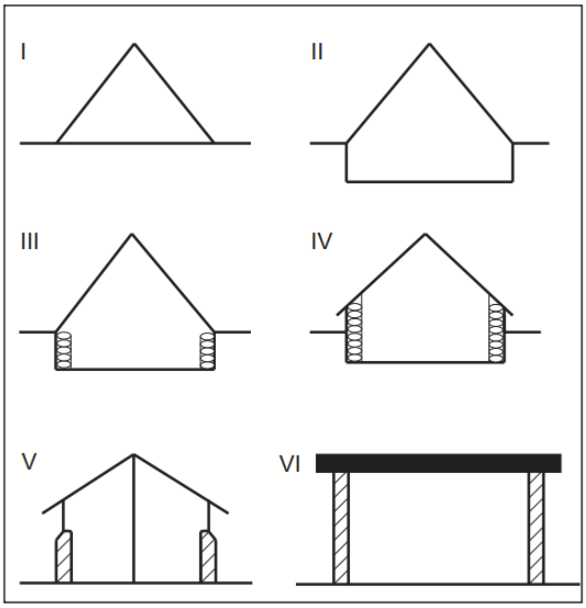

Fig. 17: Variant I of round-house plan development (Białowarczuk 2016, Fig. 2)

The second variant consisting of the conversion from shelters to large subterranean houses included five stages:

Stage I-IV: the evolution followed the same pattern as in the first variant,

Stage V: semi-subterranean or subterranean houses with strengthened construction and covered with a flat or slightly sloped roof. The problem of increasing diameter of houses was solved by the creation of internal division and exploiting inner walls for support (e. g. Jerf el-Ahmar). The roof-support system consisted of 2–4 or more pillars or poles (Białowarczuk 2016, 587–588).

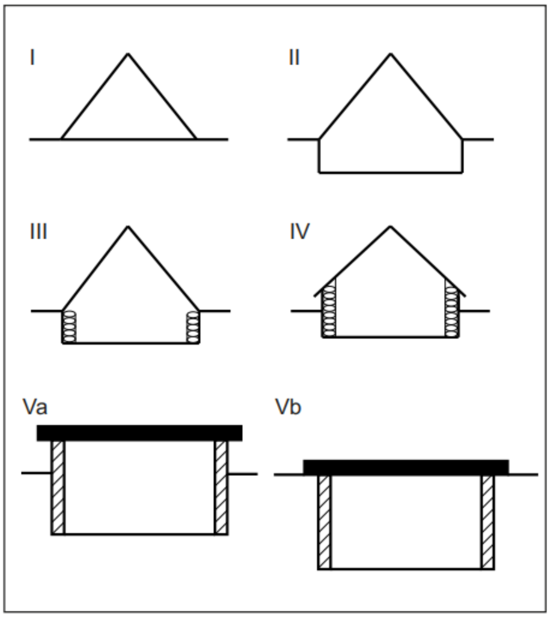

Fig. 18: Variant II of round-house plan development (Białowarczuk 2016, Fig. 4)

The geographical distribution is apparent: the first variant is dedicated to the northern Levant while the second variant was present in the southern Levant, northern Mesopotamia, and the Taurus Mountains (Białowarczuk 2016, 587).

The development of houses in the northern Levant led up from the enlargement of internal space by constructing the agglutinative buildings to the straightening of curvilinear walls and the subsequent appearance of subrectangular and later rectangular houses. It seems, that this development pattern from circular to rectangular represented the effort to enlarge usable floor internal area (Białowarczuk 2016, 588).

On the other hand, the evolution of buildings of the second variant (characteristic for northern Mesopotamia, Taurus region, and the southern Levant) shows the lack of free-standing building, agglutinative shapes and therefore multi-roomed rectangular houses. after primitive round semi-subterranean huts, a lightweight flat-roofed, subterranean structures became dominant. Enlargement of monocellular building and well-planned multifunctional use of internal space is also typical especially for northern Mesopotamia.

Architectural plan in southern and central Levant did not manifest in a huge diversification, dominating by traditional round or oval monocellular subterranean structures with few later attempts at straightening the walls (Białowarczuk 2016, 588-589).

“Social” approach

The “social approach” of examining the architectural change is closely connected to the very broad topic of which might be called the “society-household” relationship. This topic consists of a plentiful number of issues, including for example the spatial organisation of inner space (Byrd 1994; Banning – Byrd 1989), a problematic of nuclear and extended households, the role of the house or the presence of monumental buildings. Due to the extremely variety of this topic, only short segment of this approach is presented here, focused on the circular-rectangular shape transition.

K. Flannery (2002) defines the change from circular to rectangular buildings as a replacement of one settlement type by another. The reasons for this change he sees in a multiple-model explanation. Included are:

a) shifts in risk acceptance between the group and the nuclear family,

b) increases or decreases in dependence on agriculture,

c), privatization of storage,

d) shifts between polygamous and monogamous marriage (Flannery 2002, 431).

The second phase of this change he considers as the growth of houses designed to hold extended families (Flannery 2002, 431). For this settlement shift he proposes four possible movers:

a) the need for larger households in connection with many tasks of a mixed farming/herding economy,

b) the greater labour needs of intensive irrigation farmers,

c) a response to the dispersed field systems resulted from communal land clearance which was followed by division of field among the participants,

d) the increased size of elite households seeking to support and directing the work of craft specialists (Flannery 2002, 431-432).

While Flannery approach the change of ground plan, more or less, as the change of economic conception and of the attitude to storage and privatization, Banning and Byrd (1989) or Aurenche (1981) or Flannery (1972) too, examine the differences between the circular and rectangular plan in terms of the spatial organization of the inner space.

Using a graph theory, Banning and Byrd defined three types of buildings, based on the: *connectivity* of rooms, *accessibility*, and the *internal division of space* (Banning-Byrd 1989, 156–157). Under these categories, they distinguish circular houses (e. g. Nahal Oren, Beidha), simple rectangular structures (e. g. Bouqras) and developed rectangular houses (e. g. Tell Mureybet). Circular and simple rectangular structures evince some similar features in the context of spatial organization: they can be described as single enclosed spaces bordered by a single opening or doorway and with very low connectivity. The connectivity is expressed by the number of connections divided by the number of vertices (such as rooms, courtyards, adjoining street-space).

In general, circular buildings are more open and lacking the hierarchical restriction on accessibility, simple rectangular are more restricted and free circulation appears only at the end of the house, while the developed rectangular buildings show an extreme of restricting accessibility by making each room accessible only through the roof and the linkage connectivity is zero (usually there are no connections between the cells).

In relation to the strongly divided arrangement of space, there is speculation that those structures might serve for large-scale storage (Banning – Byrd 1989, 156–157).

2.4 PLANTS AND ANIMAL´S DOMESTICATION

Domestication of plant and animal species represents one of the key processes of neolithization at the beginning of the Holocene. The goal of this chapter is to provide a basic description of domestication, including a description of basic principles, the evolution of this process, and summarizing current perspectives of the issue.

At the beginning, it is necessary to clarify the terms of *domestication* and *cultivation* and emphasized the difference between them. In a figurative sense, they represent the distinction of the Neolithic and Epipalaeolithic subsistence systems.

While the cultivation is not time-limited and prehistoric populations might pursue the cultivation practice for a long time, probably during the whole Upper Palaeolithic, domestication represents a relatively short-time process occurring at one place or multiple centres.

Moreover, the cultivation is an independent process, however essential for the presence of domestication syndrome and in the context of society and ecosystems co-evolution, the long-lasting cultivation activities were most probably more important than the final domestication itself (Beneš 2018, 138). Besides, cultivation is considered a human activity while domestication consists of genetic and morphological changes within the plant that people cultivate (Fuller et al 2010, 14).

The clearest archaeological indicators of cultivation are the “hard” domestication traits, i. e. non-shattering rachises and the loss of germination inhibition. Their presence must be understood as the end of a biological evolution process and before the domination of domestication traits in the population, the plants are considered still under pre-domestication cultivation (Fuller et al 2010, 14).

The increase of domestication across species is apparent in grain size which greatly varies with different species (25–39% increase of grain in emmer and rice, 80% in pearl millet, and 100% in mungbean seed length) (Fuller 2012, 137), however, the grain size itself depends more likely on the position of the ear and the environmental conditions than on genetic diversity (Tanno – Willcox 2006).

As said above, the presence of “classical domestication signs”, i.e., non-shattering ears and inability to suppress the germinability, are by D. Fuller considered already as a result of domestication and not the commence of it and at the very end of the whole process other signs appear, such as the grain size and shape change. At a certain moment of pre-domestic cultivation, the ratio of non-shattering/tough rachis increased independently on human intervention and people were basically forced to favour non-shattering plant taxon, co-called “domestication trap” (Beneš 2018, 166).

This concept describes domestication not as an intended strategy but as more or less accidental process which trapped the Epipalaeolithic population and changed the human society together with its ecosystem. Recent conception is based on the idea of polycentric evolution (Gebel 2004) with several *local domestication events* with relatively independent evolution. For example, the regional domestication event of *Triticum diococcum* is located around the Euphrates in today north Syria, places of origin of other species of domesticated wheat were placed to southeastern Turkey. Such differences lead to the discussion about the questionable determination of the certain place of “determination event” (Beneš 2018, 166).

According to recent consensus, the stabilization of the intensive use of plants in the Near East was supported by the commencement of Bölling-Alleröd interstadial (Beneš 2018, 138). The productivity of ecosystems increased: many plant species started to be exploited by the late Epipalaeolithic and wild plant species diversified the late Epipalaeolithic diet. It was supposed formerly that during climatic deterioration in Younger Dryas the Late Natufian population reacted by an intensification of the wild plant management. However, the most recent examination shows that the reaction was more probably reflected by broadening the spectrum of exploited plants. This diversification correlated with the extension of using the stone industry (Beneš 2018, 139). This shift in subsistence economy was called the *broad spectrum revolution* (BSR) (Zeder 2012) which embraced also the beginning of domestication of animal species and *optimal foraging theory* (OFT; see below).

On the contrary, harvesting techniques of the Epipalaeolithic populations did not support the development of domestication syndrome: the method of shaking mature ears into baskets supported the growth of plants with brittle spikelets and it did not push forward the process of domestication itself (Beneš 2018, 143).

Therefore, the Epipalaeolithic and early Neolithic (PPNA) populations did not contribute directly to the final stage of domestication itself but affected the ecosystem by long-lasting cultivation of wild cereal and other plant species and helped to launch the domestication process.

One of the earliest evidence of occurrence of the domesticated syndrome with crops was examined at Zahrat adh-Dhra´ 2 in Jordan. Besides cultivated taxons of barley, wheat, and pulses, witnessed the pre-domestic cultivation, also some domestic types of barley were discovered (4 definite, 7 probable, and 2 dubious) (Edwards et al 2004, 42). Their age was dated to 9160 – 8830 cal BC, within the final PPNA (Asouti – Fuller 2012).

Another site of high importance, dated to the EPPNB is Tell Aswad; besides a high amount of tough rachis of barley, the chaffs born some characteristic of domestication and fully domesticated lentils also appeared (*Lens culinaris*). Therefore, Tell Aswad represents the earliest evidence of a fully domesticated plant in the Near East (Beneš 2018, 180). Palaeobotanical assemblages from Syrian tells Mureybet Dja´de and Jerf al-Ahmar located around middle Euphrates evidence the slow domestication of barley. Especially the situation from Jerf al-Ahmar is unique where the spatial structure of botanical material in floor declared special separated treatment with barley in the area of so-called "kitchen". Besides Syria, traces of domestication come also from areas around Damascus (Beneš 2018, 170).

The oldest collection of domesticated plants (einkorn/emmer wheat and barley) comes from Cyprus from the size Kissonegra-Mylouthkia, dated to 8500–8300 BC (Beneš 2018, 173). Another charred plant remains come from the site Klimonas (barley and emmer wheat) (Vigne et al 2012, 8447). However, the situation in Cyprus is specific: the island always remained relatively isolated with an abundance of endemic species. The earliest occupation of Cyprus is rather late, dated to ca 12 500 BP cal (Beneš 2018, 172) and the primitive wheat, cultivated by the local inhabitants, was introduced from the mainland (Vigne et al 2012, 8447).

The process of replacing the wild taxons with domesticated plants continued during the whole PPNB. What should be emphasized is the fact, that the evolution of plants towards the domesticated forms correlates with the commence of the earliest rectangular buildings. Such a chronological correlation was discovered at Beidha (Jordan) where the earliest evidence of domesticated plants corresponded with the first occurrence of right angles in architecture (Beneš 2018, 180).

Several approaches defining the most recent state of research could be highlighted from the contemporary literature.

Firstly, collections of new archaeobotanical data from the Near East state that domestication was a slow process lasting circa 3000 years, as concluded by Tanno and Willcox (2006). The changing proportion from wild to domesticate morphotypes was observed by the compilation of chronological series of data from six Near Eastern sites (Fuller 2012, 132). Another comparison was made by Fuller (2007) who had focused his analysis on einkorn and barley and compared them separately, concluding that non-shattering wheat (ca. 1500 years) probably evolved faster than barley (ca. 2000 years).

Therefore, it might be stated that domestication was a slower process than expected before and with far weaker artificial selection. The selection could be also discontinuous and not uniformly directional (Fuller 2012, 132).

Secondly, there is a new approach to examining domestication development. Unlike previous research which was based on the observation of morphological changes in the cereal diaspores, the new conception is focused on statistical index of ratio domestic and non-domestic traits on plants, including the ratio between and non-shattering spikelet (Beneš 2018, 142).

The process of animal domestication was based on the gradual and long-term selectivity in hunted species which resulted in the breeding itself. Similarly, as in the case of plant domestication, the commencement of the change was initiated considerably earlier before the process was completed and even before any morphological changes on the osteological material became evident. This conclusion also reflects a new approach to the perception of domestication: while up to now, the body-size reduction was considered as the primary marker evidencing animal domestication: however, recent analysis shows that domestication status did not affect female body sizes and only on a limited scale on males. On the contrary, body-size reduction of wild animals was result of different selective strategies by hunters. Their intention was to hunt primarily large adult males, unlike early Neolithic "herders" who favoured culling young males and keeping females till their peak fertile maturity (Zeder 2011, 226).

The change of hunting strategies at the end of the Epipalaeolithic is seen as a crucial moment in the development from hunting animals to farming. On the base of site Hallan Çemi in south-eastern Anatolia, R. Redding (2005) postulated the theory of the *male-sink model*. His theory is based on the principle of hunting adult sexually active males out of the area within one day´s walk of the base camp: this situation enables a space for other males and attracts them from the broader area. This method allows the hunters manipulate by far larger area than one group could do under normal circumstances. A side effect of this method is the general change of demography of the herd (Redding 2005, 45). This model supports the assumption that although the animal species hunted by Epipalaeolithic hunters do not evince any morphological signs of domestication, such a change in hunting strategies led to latter remote management of herds, change of their structure, and resulted in the fully farming treatment.

Evidence about the beginning of domestication in central Zagros mountains weas detected at the site Ganj Dareh: osteological assemblages, dated to 9900 cal BP, showed marks of selective hunting young males and evidence of slaughtering female goats at a higher age. A similar principle was observed at the site Ali Kosh in southwestern Iran, with the earliest occupation dated to 9500 cal BP. Clearly visible changes in morphology documented on the size and shape of goat horns reflect the impact of human encroachment into the management and composition of wild herds (Zeder 2011, 226–227).

The transitional strategy between hunting and breeding, probably in some form of early herd management, is observable at the sites in southeastern Anatolia, Körtik Tepe (ca. 10 900 cal BP) and Nevali Çori (10 500 cal BP), both dated to PPNA period. Peters (Peters et al 2005) noticed changes in the age and size only on sheep remains from Nevali Çori, while goats were introduced there later, around 10 200 cal BP (Zeder 2011, 227).

The earliest appearance of goats in north Levantine assemblages comes from Abu Hureyra (ca. 9 600 cal BP) where a similar selection strategy as at Ganj Dareh is observable. In this area, goats seem to replace gazelle as the main hunted animal and started to predominate around 9 300 cal BP. The same pattern of the shift in the composition of hunted animals followed in the south Levant. Replacement of gazelle by goats in Jordan valley is dated to MPPNB (10 000 – 9 200 cal BP), however, in the Mediterranean coastal area remains the stress on hunting gazelle until the final PPNB/PPNC. Bringing managed sheep into the south Levant was delayed, as well as into Fertile Crescent: in the Levant around 9200 cal BP, in Zagros area around 9000 cal BP (Zeder 2011, 227).

The theory about spreading the domestication of caprine from Anatolia southward is not accepted unanimously though: L. Horwitz sees domestication as an autochthonous process rather than as introduced from northern areas and supposes that goats were domesticated locally in the southern Levant, (Horwitz 2003). She supports up this assumption by the presence of both ibex and bezoar goat at the same sites and the fact, that ibexes were treated by the same culling selection as wild goats, as shows data from Wadi Tbeik (Horwitz 2003, 52).

In general, new approaches and recent archaeobotanical analysis indicate that domestication, both plants, and animals, was a much slower process than it has been expected before. An essential part of this process, which launched the domestication long before their impacts were observable, was cultivation of plants, different hunting strategies, and remote management of herds. Cultivation was probably pursued during the whole Upper Palaeolithic and the domestication of plants was an accidental process independent on human practices; more probably it influenced the social development of population than the other way around.

It is supposed that in the Near East the domestication process occurred in several independent places, operating on the base of polycentric evolution. That means that plants with domestication syndrome appeared in local domestication events, namely in the Zagros mountains area, north Levant, and southeast Anatolia.

The domestication process of animals was slower than with plants, based on the changes in hunting strategies. Remote management of animals subsequently led to the transformation of herds and the created tighter reliance between the human population and animals.

Evidence of the earliest form of herd management of wild sheep comes from south-eastern Anatolia, the centre of domestication of wild goats might be placed into the area of Zagros mountains.

In any case, it is necessary to perceive domestication as a long-lasting and complex process that is not connected to one event in space and time but as a series of more or less accidental effects commenced in the Upper Palaeolithic and resulted in a new form of society characterized by stable settlements and domesticated faunal and floral species in 9th millennium BC.

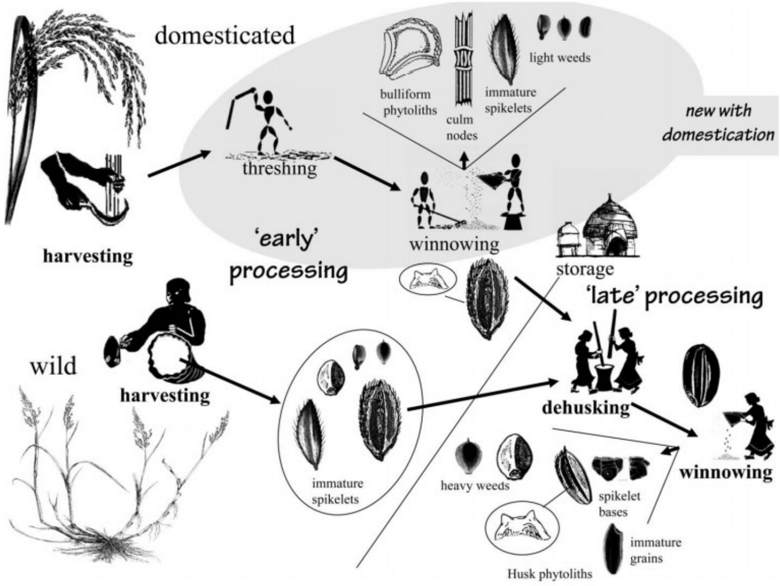

Fig. 19: Comparement of the crop-processing stages of domesticated crops and wild harveseted crops (Fuller e al 2010, Fig. 1)

3. EVALUATION

The data core of my thesis constitutes 30 sites in total from northern and southern Levant. Chosen sites are represented as follows: 8 sites from northern (27% in total) and 22 from the southern Levant (73% in total). The sites were chosen according to the combination of two main criteria:

a) either the presence of the transitional ground plan

b) or according to the demarcated chronological range (LPPNA – MPPNB).

The total number of evaluated sites, unfortunately, did not allow to define the criterions stricter and this architectural and chronological combination represents a compromise according to the lack of valuable and relevant sites.

Under these criteria, individual sites were compared and evaluated on several levels. Three categories of the ground plan were evaluated: *circle*, *transitional* and *rectangular*, while each category consists of several sub-categories of plans. The terminology follows the appellation from the source literature, if possible[5]:

<u>Circle (C plan)</u>: circle, curvilinear, oval, round, elliptical, rounded single-celled, irregular, oval/subcircular,

<u>Transitional (T plan)</u>: polygonal, transitional, biconvex, curvilinear rectangle, rectilinear/curvilinear, parabola, oval/rectilinear, "pie-shaped", "tea-drop", curved, rectangular/rounded corners, subrectangular,

<u>Rectangular (R plan)</u>: rectangular, rectilinear, corridor, square, rectilinear trapezoid, quadrilateral, irregular quadrilateral,

<u>Irregular (X)</u>: amorphous, irregular, not defined.

Buildings of the irregular plan were not included in the final evaluation since irregular plans do not represent a relevant variable in the evaluation. However, they are included into the general survey below.

[5] detailed architectural description available in the database

The topic is viewed and evaluated from two diverse perspectives: chronological and environmental. The chronological perspective observes a process of changing the ground plan in different regions in time and compares the ratio of occurrence the individual plans in different chronological phases. The environmental perspective compares the occurrence of particular ground plans within the highly variable environment of northern and southern Levant territories. Sites are evaluated and compared considering the diverse environmental aspects of each of the area, primarily the potential influence of annual precipitation rate, the altitude and individual environmental zones defined according to phytogeographic zones.

During the evaluation two main difficulties emerged, which forced me to divide the evaluation these two perspectives. Firstly, a problem with the detailed chronology based on calibrated radiocarbon dates emerged, consisting of the unequal dating of individual sites. Some sites with a longer occupational history and high state of research provided a plentiful scale of radiocarbon samples (e. g. Beidha, Jericho, Tell Qaramel), which enabled me to choose only the dates corresponding with the selected chronological range of LPPNA – MPPNB. On the contrary, other sites did not provide any samples for radiocarbon analysis at all, and their dating was therefore based purely on the artifacts (e. g. Ainab 1, Mujahiya). Moreover, in the case of accessible dates for calibration, they often did not belong directly to the evaluated houses but came from different contexts. They might be assigned to the individual context or layer only in the case of larger sites, while on smaller one-phased occupation sites it is not possible (e. g. Horvat Galil).

Secondly, a similar problem as with the non-consistent radiocarbon dating emerged in the case of the relevance of individual sites. There is a huge difference within evaluated sites concerning the number of appraised buildings, ranging from 1 to over 60 buildings. Therefore, to each of the sites, a certain “rate of accuracy” (RAC) was assigned:

RAC	number of evaluated buildings on the site[6]
RA1	1–4
RA2	5–15
RA3	16–100

Within the environmental model, sites were evaluated only under a broad chronological scope of LPPNA – MPPNB, while the attempt of detailed categorization according to radiocarbon dates reflects only the occurrence and spreading of ground plans throughout the Levant, regardless of the environmental conditions.

3.1 CHRONOLOGICAL X ARCHITECTURAL PERSPECTIVE

The chosen chronological range allowed two courses of the research:

a) observing the commencement of the right-angle shapes based on detecting the early transitional ground plans in a time scale of LPPNA – EPPNB phases,
b) describing the process of spreading the rectangular shapes within the whole chronological and geographical range. This course allows to observe the development of buildings from LPPNA to MPPNB and covers the shape variability of different environmental regions including later phases of PPNB.

The dating was based (if possible) on the radiocarbon dates obtained from different sources (detailed table included), in ^{14}C BP form, and therefore calibrated (Tab. 6). The dates were sorted according to two chronological systems, Maison de l´Orient (1981) and the Ex Oriente (Tab 4., 5.). According to them, several phases were distinguished, based on the individual radiocarbon dates series which was accessible.

[6] Only C, T, and R plans are included. Irregular buildings were omitted

dating	Neolithic phases
12 000–10 000 cal BC 12 200–10 200 BP	Natufien
10 000–9 500 cal BC 10 200–10 000 BP	Khiamian
9 500–8 700 cal BC 10 000–9 500 BP	PPNA: Sultanian, Mureybetian Transition phase PPNA-PPNB (Jerf al-Ahmar)
8 700–8 200 cal BC 9 500–9 200 BP	EPPNB (PPNB ancient) (Euphrates: north Syria, southeast Anatolia)
8 200–7 500 cal BC 9 200–8 500 BP	MPPNB (PPNB moyen)
7 500–7 000 cal BC 8 500–8 000 BP	LPPNB (PPNB récent)

Tab. 4: The chronology of early Neolithic phases by Maison del´Orient 1981 (Helmer - Gourichon - Stordeur 2004, Tab. 1)

dating	Neolithic phases
9800/700 (Ph1) 9300/200–8800/700 BC (Ph2)	PPNA
8800–8600 BC	Transitional PPNA/PPNB phase
8600–8300/200 BC	EPPNB
8300/200–7800/500 BC	MPPNB
7800/500–6900? BC	LPPNB

Tab. 5: The chronology of early Neolithic phases by Exoriente (https://www.exoriente.org/associated_projects/ppnd_summary.php)

In the total number of 30 sites, 8 of them belong to the northern Levantine area while 22 is southern Levantine location. They were divided into five chronological groups; most of them provided radiocarbon data, 7 sites (Abu Salem, Ein Qadis, Nahal

Hava, Nahal Yarmuth, Ainab 1, Majuhiya, Nahal Betzet) were classified according to the chipped stone industry. Therefore, their classification into a certain group was based on the comparison of accessible radiocarbon dates and general dating of the stone industry.

Chronological phases (with approximate chronological range)[7]:

LPPNA – EPPNB: 9965 ± 55 – 8570 ± 150 BP (9743–9297 – 8201–7197 cal BC)

EPPNB: no RC dates available, stone industry dating

EPPNB – MPPNB: 9805 ± 115 - 8546 ± 100 BP (9743–8829 – 7939–7347 cal BC)

MPPNB: 9590 ± 90 – 8365 ± 120 (9249–8715 –7591–7078 cal BC)

M/LPPNB: 9195 ± 70 – 8850 ± 90 (8611–8283 – 7935–7361 cal BC)

Results of individual chronological phases

LPPNA – EPPNB

Sites ranging on the boundary between LPPNA and EPPNB were classified in this phase. This group represents the most numerous represented one; it includes 8 sites with a relatively high number of evaluated buildings. Also, the ratio of RAC is relatively high, concerning two RA3, three RA2 and only two RA1 sites. Although the circular plan is predominant (49%), transitional plan is present the most from all phases, by 22%. Rectangular plan occurred by 29%. Most of the sites are northern Levantine provenance (75%), including essential sites such as Tell Mureybet or Jerf el-Ahmar.

[7] The earliest and youngest dates range available from the sites.

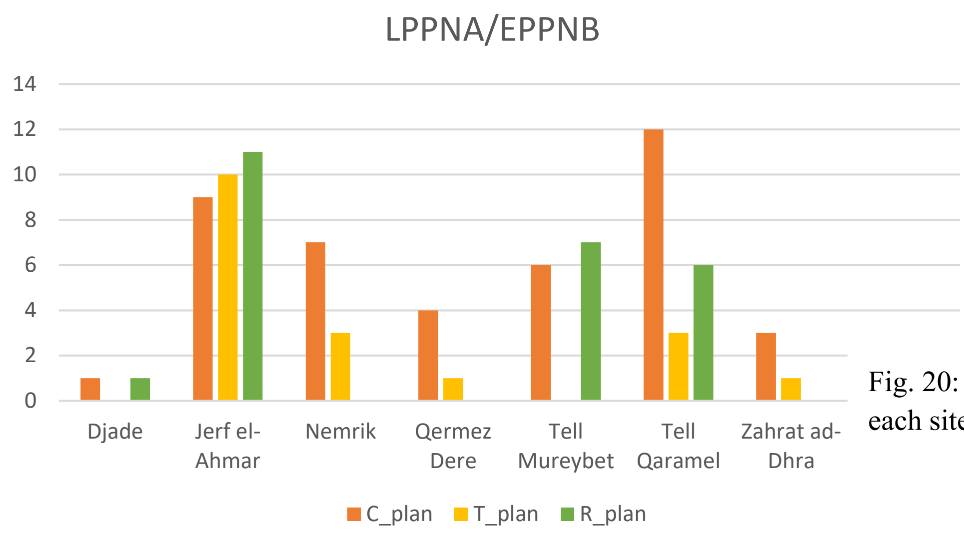

Fig. 20: Number of individual plans on each site dated to LPPNA/EPPNB range

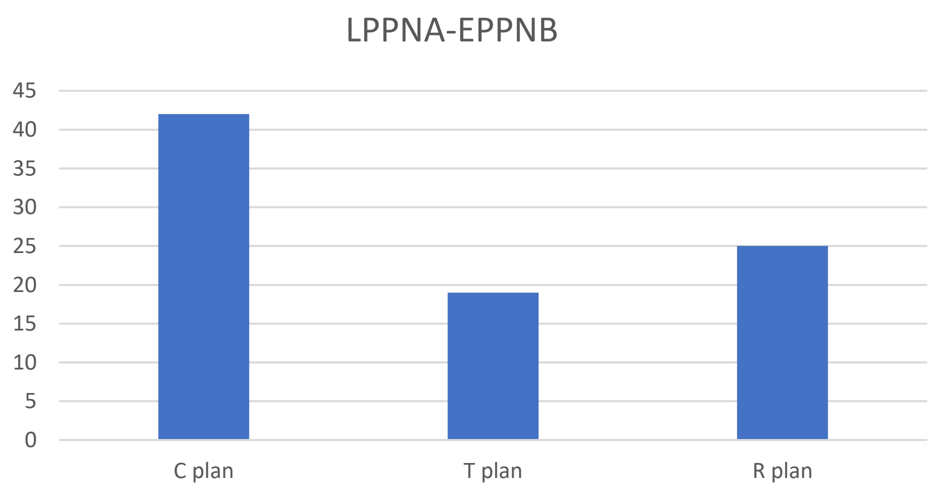

Fig. 21: The total number of individual plan types in the LPPNA – EPPNB chronological range

EPPNB

Within the category of purely EPPNB only three sites were evaluated: Ainab 1, Mujahiya, and Nahal Betzet I. Unfortunately, these sites did not provide any radiocarbon dates, therefore their dating was based purely on the stone industry. Moreover, the rate of accuracy of these sites is low according to the extremely small number of evaluated buildings, ranging from one to two.

Only circular and rectangular plans occurred, while the circular plan was predominant (83%) and rectangular plan occurred only once at the Nahal Betzet, I together with one circular house (17%). These sites represent a group with a relatively low rate of accuracy and therefore a low relevance.

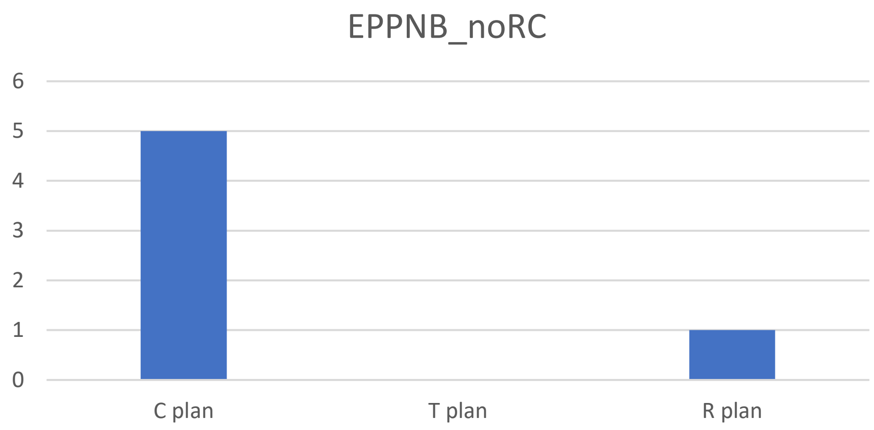

Fig. 22: The total number of individual plan types in the EPPNB chronological range (with no available C^{14} dating)

EPPNB – MPPNB

This group is difficultly evaluable due to several reasons. Firstly, sites in this group are relatively broadly chronologically ranged. The radiocarbon dates correspond both with the early and middle phases of PPNB, just as their dating according to the stone industry. Both phases were present at the sites, and apart from the site Beidha, the number of evaluable buildings in this category is too low to be assessed properly.

Secondly, the RAC of the individual sites differs considerably. Besides Beidha, all sites belong to RA1 group which means a very low rate of accuracy. On the other hand, Beidha evinces the highest rate of accuracy, RA3, which might considerably distort the final evaluation.

Similarly, as in the case of previous groups, circular plan is the most frequent here, present by 68,2%. Transitional plan occurred relatively low (11,4%), considering the early phase of PPNB. Rectangular plan is present in 20,5% within the group. Concerning the geographical placement, southern Levantine provenance prevails (4 sites from 6 sites in total).

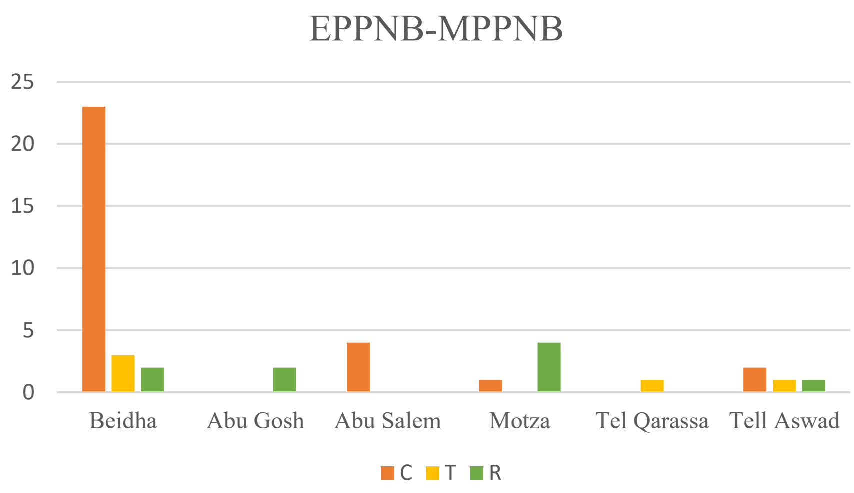

Fig. 23: Number of individual plans on each site dated to EPPNB-MPPNB range

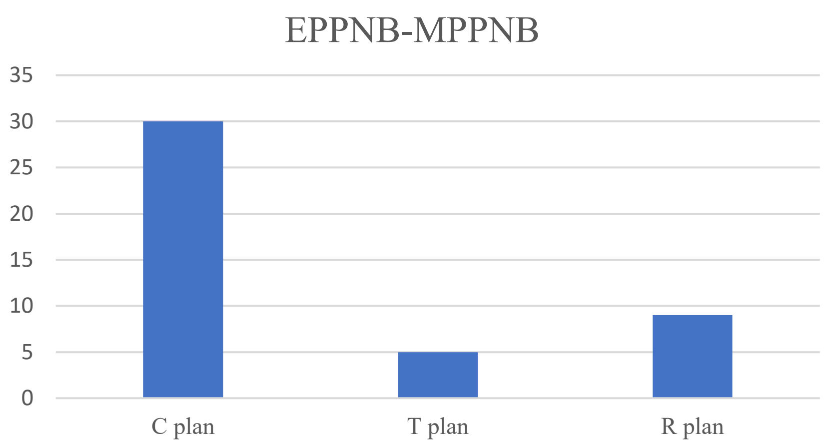

Fig. 24: The total number of individual plan types in the EPPNB – MPPNB chronological range

MPPNB

Under the MPPNB group, partly radiocarbon (Nahal Efe, Shkarat Msaied, Ain Abu Nukhayla) and non-radiocarbon dated (Munhata, Ein Qadis, Nahal Hava, Nahal Yarmuth) sites were categorized. The high ratio of low RAC sites is problematic here as well; RA1 sites prevail (5 sites in total), consisting only of one- or two-buildings sites. Besides them, only one RA3 site was present. Within this group, circular plan is the most frequent (69,2%), followed by rectangular plan (17,9%) while the transitional plan is present only by 12,8%. However, considering the number of transitional plans on individual sites, Ain Abu Nukhayla represents one of the most numerous one (four T plans in total), together with Jerf el-Ahmar (10) and Beidha and Nemrik (3). Unlike previous groups, all the evaluated sites belong to the southern Levantine provenance.

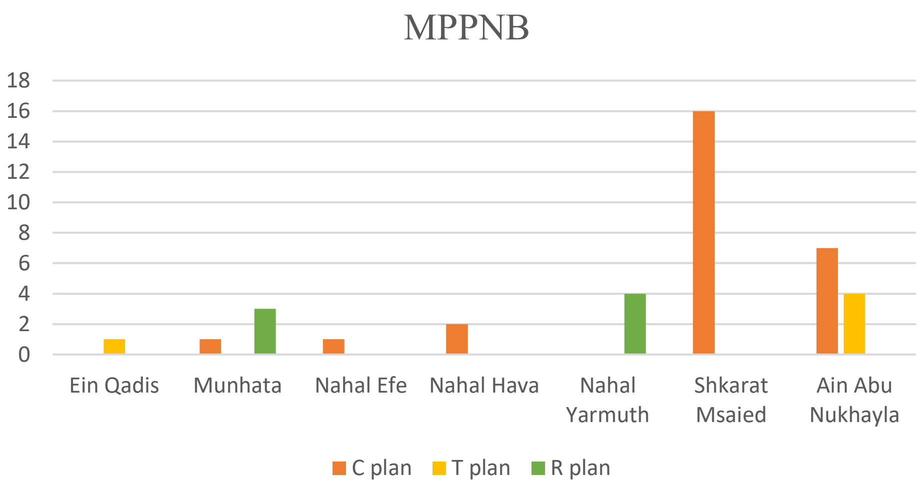

Fig. 25: Number of individual plans on each site dated to MPPNB range

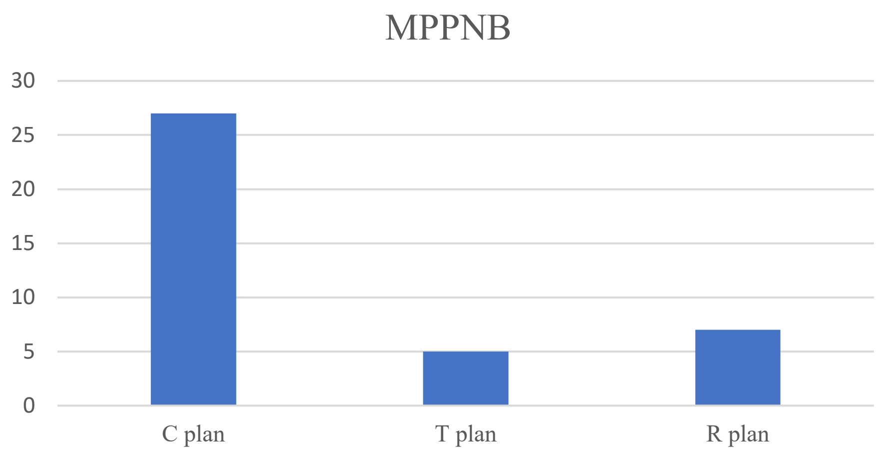

Fig. 26: The total number of individual plan types in the MPPNB chronological range

Sites included in this group represent the youngest phase of evaluation, on the very edge of the evaluated chronological range. This chronological group reflects the high variability of ground plans within the chronological and geographical range; despite considerably late phases, characteristic by highly developed right-angled buildings in general, within this group circular plan remains as a prevailing plan (52,6%), followed by rectangular plan (36,8%). Transitional plan is also present, however only by 10,5%. The RAC is rather low, most of the sites belong to RA1 or RA2 which unfortunately belittle the relevance. All sites belong to the southern Levantine provenance as well.

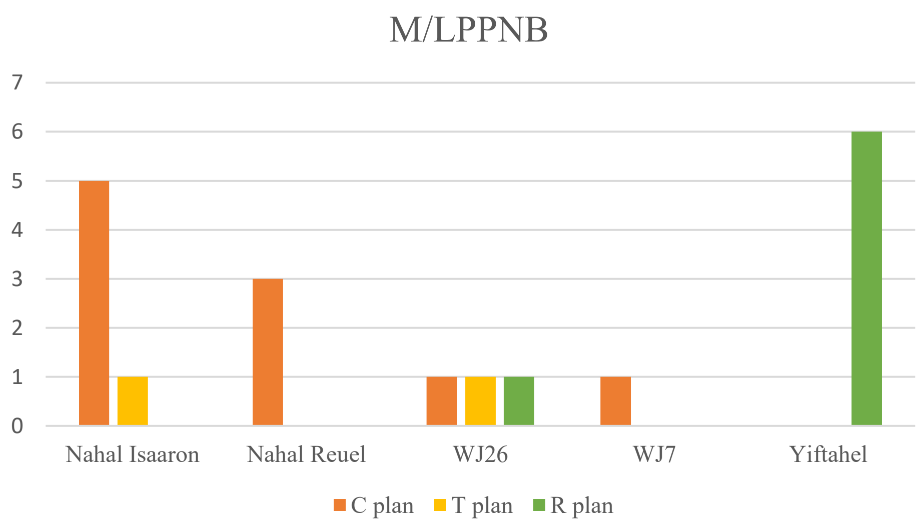

Fig. 27: Number of individual plans on each site dated to M/LPPNB range

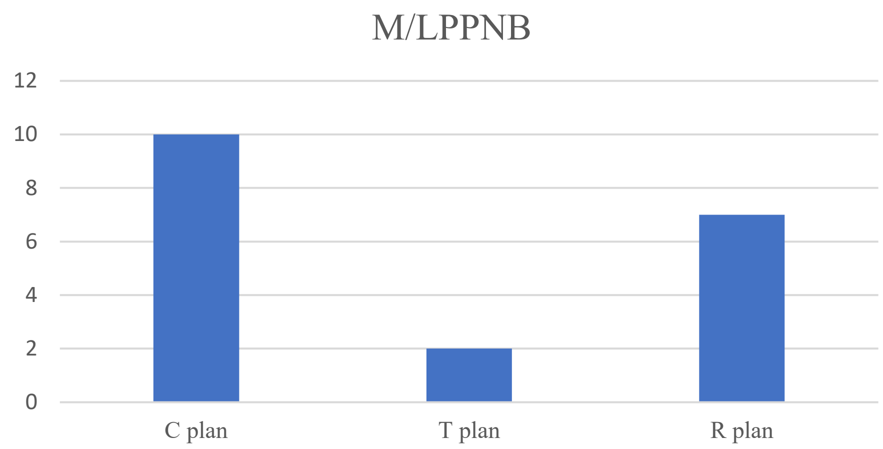

Fig. 28: The total number of individual plan types in the M/LPPNB chronological range

<u>Transitional plan: chronological and geographical distribution</u>

The collation of evaluated data in the database proved a clear dominance of transitional ground plan type at the turn of the LPPNA – EPPNB period. From the total number of 30 detected sites, when transitional plan buildings occur through all chronological phases, 60% of structures belong to the earliest period. The ratio of transitional plans within EPPNB – MPPNB and MPPNB periods is considerably lower (16,7%). The lowest number of transitional plans occurred in the youngest phase, in the latest phases of middle PPNB, only 6,7%.

Also, the prevalence of transitional shapes in the northern Levant was proved. This conclusion correlates with the generally accepted assumption about the development of rectilinear architecture from the north southward (Edwards 2016, 67).

Both the ascertainments correspond with the conclusion about the earliest occurrence of transitional and early right-angled buildings in the northern Levant, especially in the middle Euphrates valley. The survey also showed a variability of broader chronological group of EPPNB – MPPNB in southern Levant with less occurrence of transitional buildings, however longer circular shapes continuity.

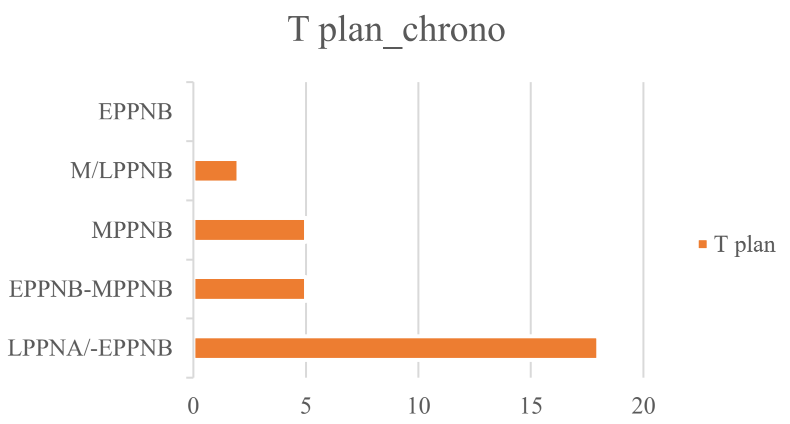

Fig. 29: Frequency of transitional plans in individual chronological ranges

<u>Middle PPNB: a chronological and geographical comparison</u>

Assessment of the later phases of PPNB, namely MPPNB and the turn of middle and late PPNB, clearly demonstrated a longer continuality of circular ground plan in the southern Levant, specifically in arid areas. This issue is yet closely connected to the specific environmental conditions of arid and steppe territories and will be more detailed discussed in within the environmental perspective.

	Chronological range	RC BP	RC cal BC oldest	RC cal BC youngest
Horvath Galil	LPPNA/EPPNB			
Zahrat ad-Dhra	LPPNA/EPPNB	9635 ± 59 – 9323 ± 59	9245	8351
Jerf el-Ahmar	LPPNA-E/MPPNB	9965 ± 55 – 9395 ± 55	9743	8485
Nemrik	LPPNA-EPPNB	9970 ± 170 – 8570 ± 150	10482	7197
Qermez Dere	LPPNA-EPPNB	9710 ± 85 – 9580 ± 95	9312	8655
Tell Qaramel	LPPNA-EPPNB	9880 ± 80 – 9420 ± 100	9740	8360
Djade	LPPNA-EPPNB	9610 ± 170 – 8990 ± 100	9450	7787
Tell Mureybet	LPPNA	9950 ± 150 – 8510 ± 80	10049	7358
Ainab	EPPNB			
Mujahiya	EPPNB			
Nahal Betzet	EPPNB			
Beidha	EPPNB-MPPNB	9128 ± 103 – 8546 ± 100	8631	7347
Abu Gosh	EPPNB-MPPNB		8251	7816
Abu Salem	EPPNB-MPPNB			
Motza	EPPNB-MPPNB	9310 ± 30 – 8890 ± 45	8699	7832
Tell Qarassa	EPPNB-MPPNB	9340 ± 70 – 8940 ± 50	8738	7956
Tell Aswad	EPPNB-MPPNB	9805 ± 115 – 9020 ± 60	9743	7961
EinQadis	MPPNB			
Munhata	MPPNB	9160 ± 500	10020	7084
Nahal Efe	MPPNB	8789 ± 40	8170	7611
Nahal Hava	MPPNB			
Nahal Yarmuth	MPPNB			
Shkarat Msaied	MPPNB	9590 ± 90 – 8880 ± 80	9249	7742
Nahal Isaaron	M/LPPNB	9195 ± 70 – 7950 ± 110	8611	6539
Nahal Reuel	M/LPPNB	8670 ± 60 – 8550 ± 90	7940	7361
WJ26	M/LPPNB	8740 ± 110 – 8690 ± 110	8204	7542
WJ7	M/LPPNB	8810 ± 110 – 8390 ± 80	8225	7191
Yiftahel	M/LPPNB	8890 ± 120 – 8570 ± 130	8289	7328
AinAbu Nukhayla	MPPNB-LPPNB	8625 ± 85/80 – 8565 ± 55	7944	7078

Tab. 6: The summary of C^{14} dates

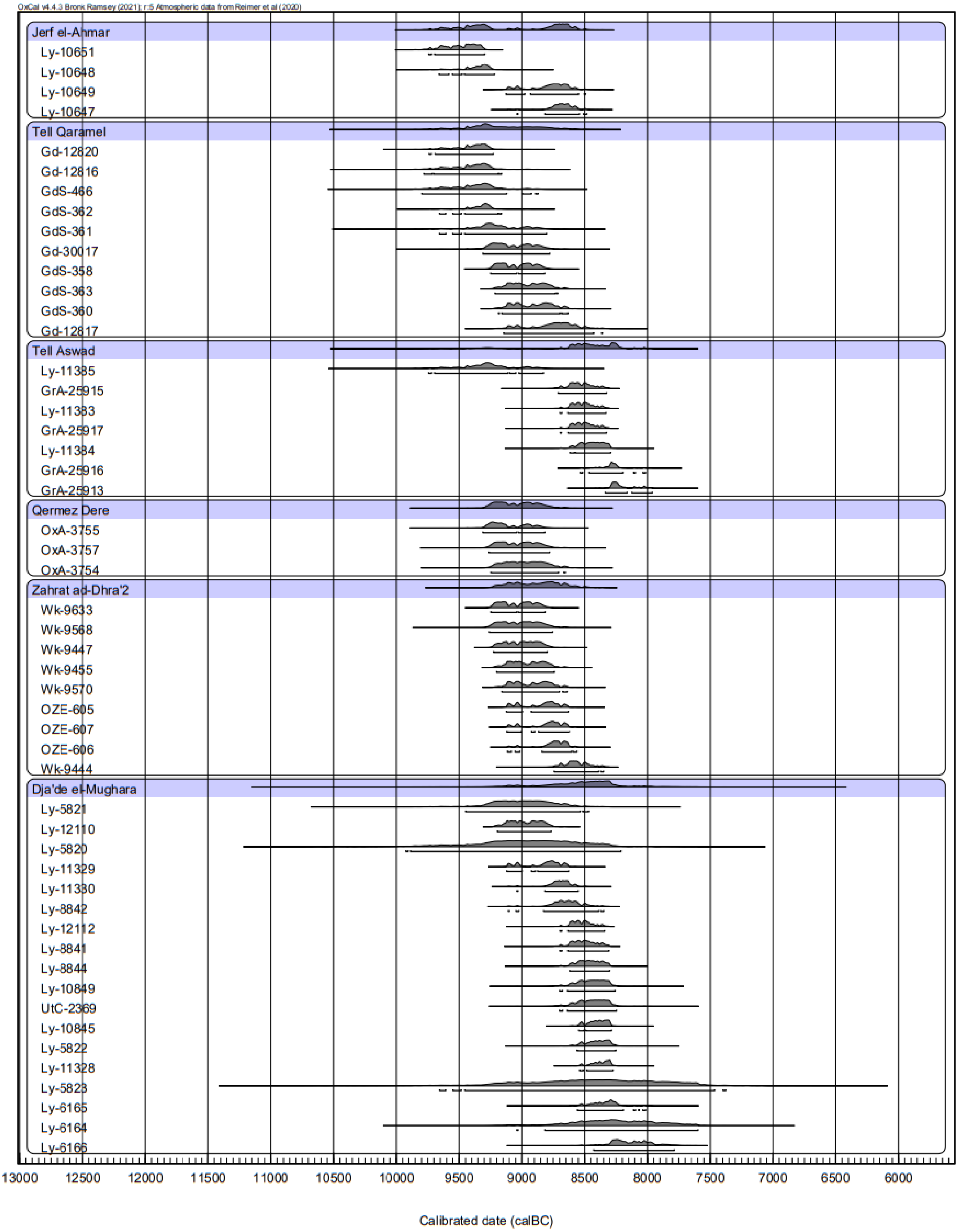

Fig. 30: The probability curves ^{14}C dates By: Vondrovský V. 2021

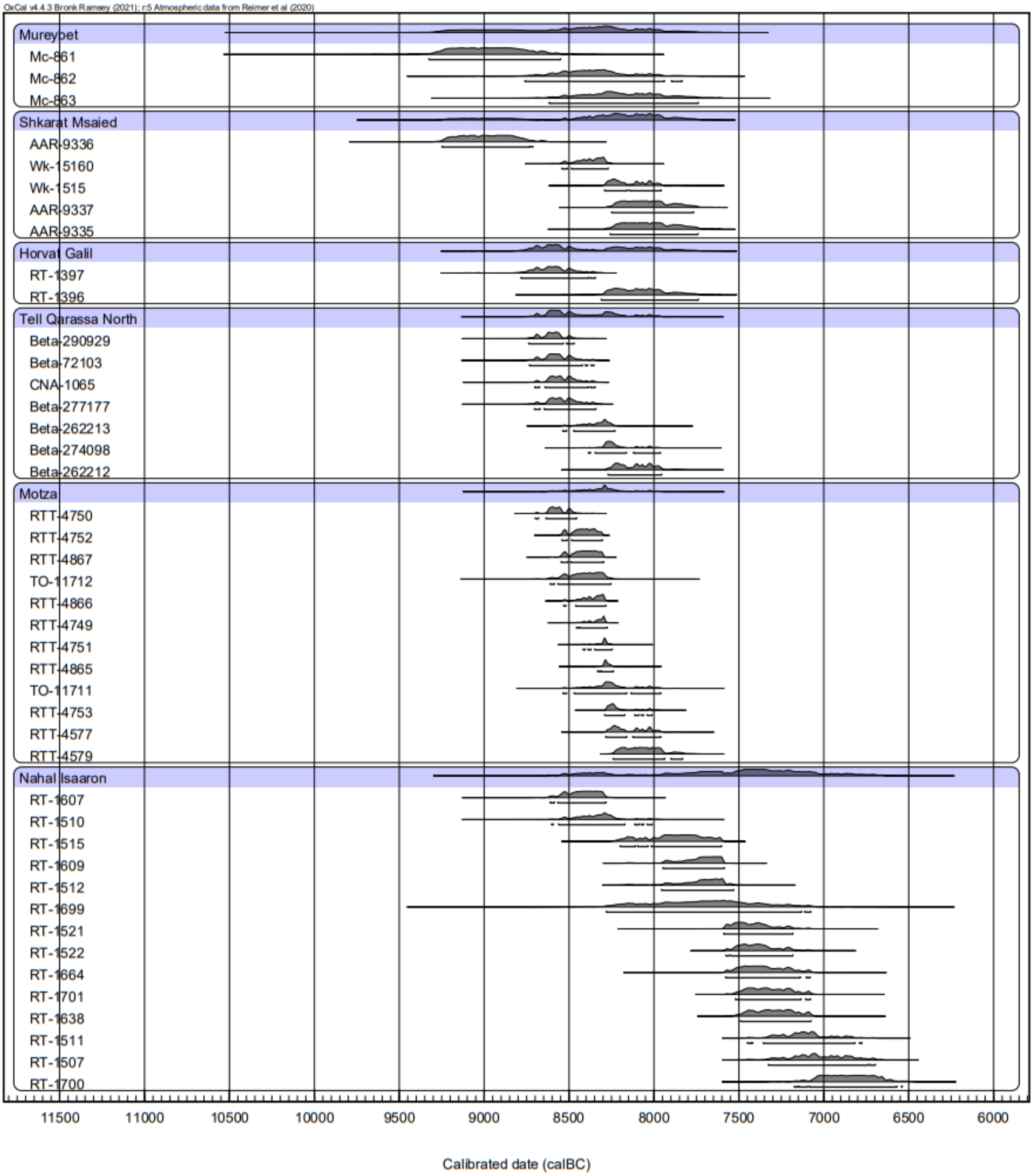

Fig. 31: The probability curves ^{14}C dates By: Vondrovský V. 2021

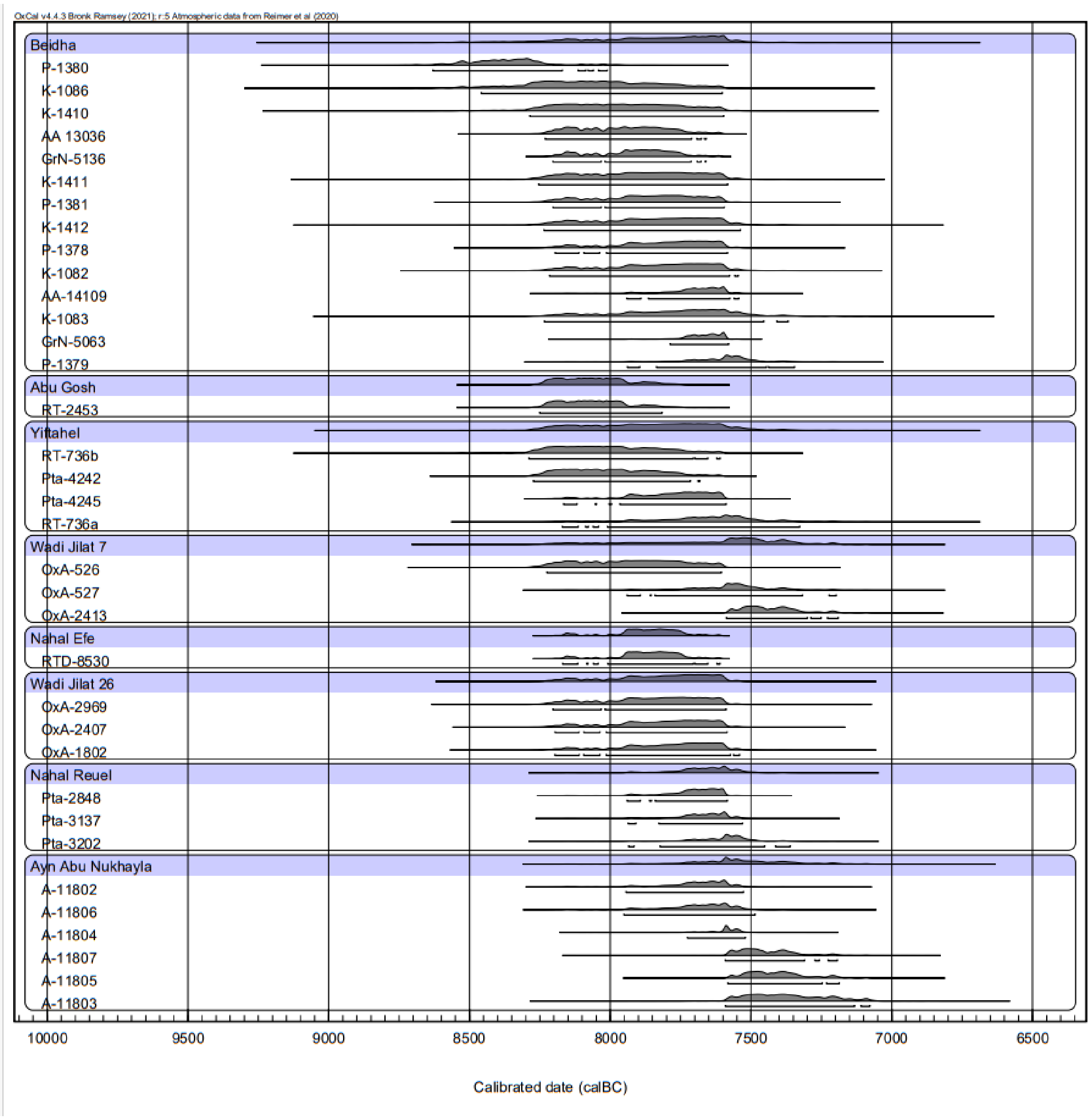

Fig. 32: The probability curves ^{14}C dates By: Vondrovský V. 2021

3.2 ENVIRONMENTAL X ARCHITECTURAL PERSPECTIVE

Testing the possible correlation between the ground plan change and different environmental factors in the northern and southern Levant was based on the evaluating four environmental and climatic categories:

a) the altitude,
b) the annual monthly precipitation (June, December; mm/month),
c) the annual monthly temperature (min/max June and min/max December; °C/month),
d) the environmental zone.

Temperature and precipitation data were obtained from the World Clim-Global climate data modelling (BCC-CSM1-1).

During the evaluation, several problems emerged. The main difficultly consisted in the very low number of evaluated houses both at each site and in total. Together with quite a high rate of the environmental variables, unfortunately, they represented an unsuitable sample for a statistical assessment.

In the end, only four statistical conclusive variables were evaluated: a) December precipitations, b) altitude, c) minimal December temperatures and d) maximal June temperatures. Moreover, the reliable values were restricted only to certain ground plan types. Namely circular plan and transitional + rectangular plan in the December precipitation category, circular plan concerning the minimal December temperatures, transitional + rectangular plan concerning the maximal June temperatures, and circular plan in the altitude category. Also, all houses together were evaluated under the altitude category.

According to the considerable higher frequency of circular plan within the evaluated sites (the median over 50%), such a pattern was predictable. The low statistical conclusiveness of the remaining parameters might be caused by a low statistical sample or because of their non-relevance.

Similarly, as in the chronological perspective of my evaluation, the problem with the extremely different rate of accuracy of individual sites emerged. Unfortunately, because of the low statistical sample in general, also RA1 sites were finally included in the evaluation. Therefore, the presence of these unreliable sites into the statistic might distort the outcome, which must be taken in consideration when evaluating the results.

Altitude:

The altitudes of evaluating sites ranging from the highest elevation 1020 m a. s. l. (Beidha) to the extreme depressions in the Dead Sea area -160m below sea level (Zahrat ad-Dhra). Such a variability with the difference over almost a thousand altitudinal metres led to the idea of its possible influence on the transition of the house plan.

Unfortunately, the only correlation within the statistical conclusive parameters seems to show some relationship between the altitude and the circular plan. Also, some correlation between the higher altitude and the more frequent occurrence of buildings in general emerged.

Evaluation of the relative values of the circular plan showed relatively steady occurrence across the whole altitude range, on the other hand, the absolute numbers showed a clear growth of circular plan frequency in higher altitudes. However, the reliability interval is higher in absolute numbers. Transitional and rectangular plans do not seem to correlate much in absolute numbers where they remain relatively stable, in relative numbers the trend of rectangular house seems to decline with the growing altitude while the transitional ground plan rises.

The results seem to be clearer in the model of the absolute numbers where the growing number of all houses strongly correlates with the growing altitude, similarly to the circular plan. This matches the most frequent occurrence of circular plan, however, not in the model of the relative numbers which shows a different pattern.

Here the statistic might face the problem with rate of accuracy individual sites; the expression of data in percentual values might distort the result.

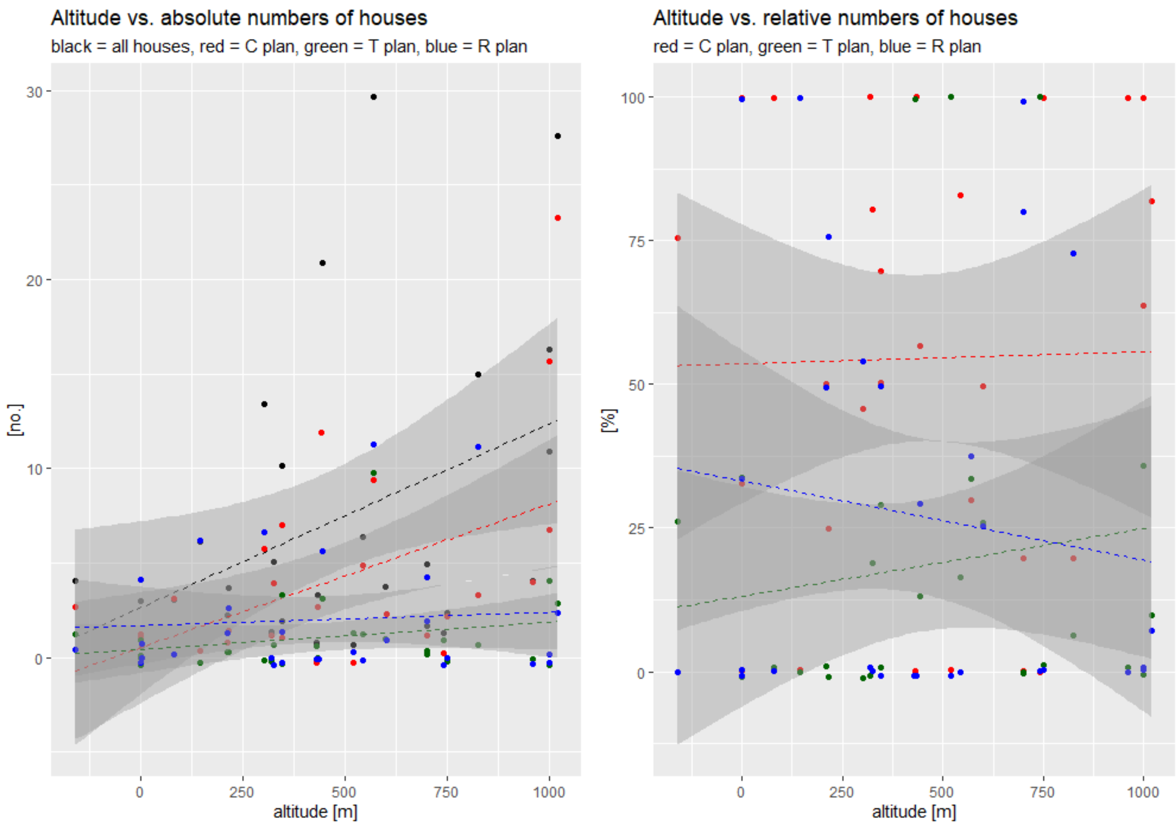

Fig. 33: Distribution of individual house plans according to the altitude (absolute and relative numbers of houses)

Precipitation

Concerning the precipitation model, only the December values were used for the statistical evaluation. However, the precipitation model seems to be distinctively clearer than the altitude.

In both absolute and relative numbers models a distinct trend is apparent: a ratio of circular plans is highest in the arid areas with zero or lower precipitation, while the transitional and rectangular ground plans are more present in the areas with a higher rate of rainfall. Such a conclusion was not unforeseen: this pattern is clearly apparent throughout the Levant and such a layout responds to the assumption about the correlation of subsistence strategies and settlement plan (i. e. Edwards 2016). A transitional plan evinces a similar trend as a rectangular one, less distinct though. However, this result probably corresponds to the smaller frequency of transitional ground plans in general.

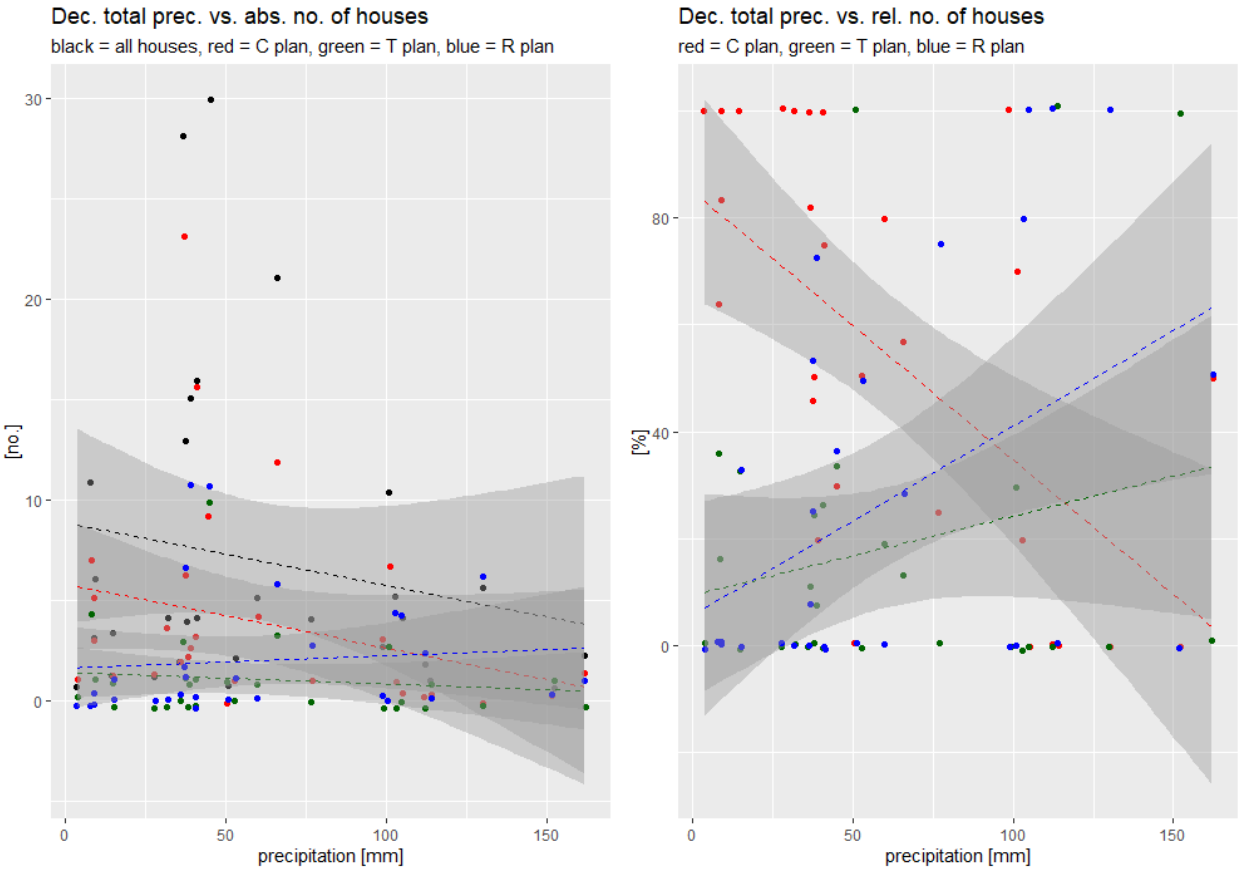

Fig. 34: Distribution of individual house plans according to the total precipitation rate in December (absolute and relative numbers of houses)

<u>Temperatures</u>

Within the temperature range, only the maximal June and minimal December temperatures were used. The difference between the results of absolute and relative numbers might be seen here again: a clearer picture comes from relative numbers when the maximal June temperatures correlate with the more frequent occurrence of the circular plan. Transitional and rectangular plans evince different trends when their presence apparently decreasing with higher temperatures.

Concerning the sum of all houses visible projected on the model of the absolute numbers, a slight increase of total buildings number with higher temperatures is visible, however, this state might be influenced by the predominance of circular plan.

The minimal December temperatures model unfortunately does not evince any meaningful correlation.

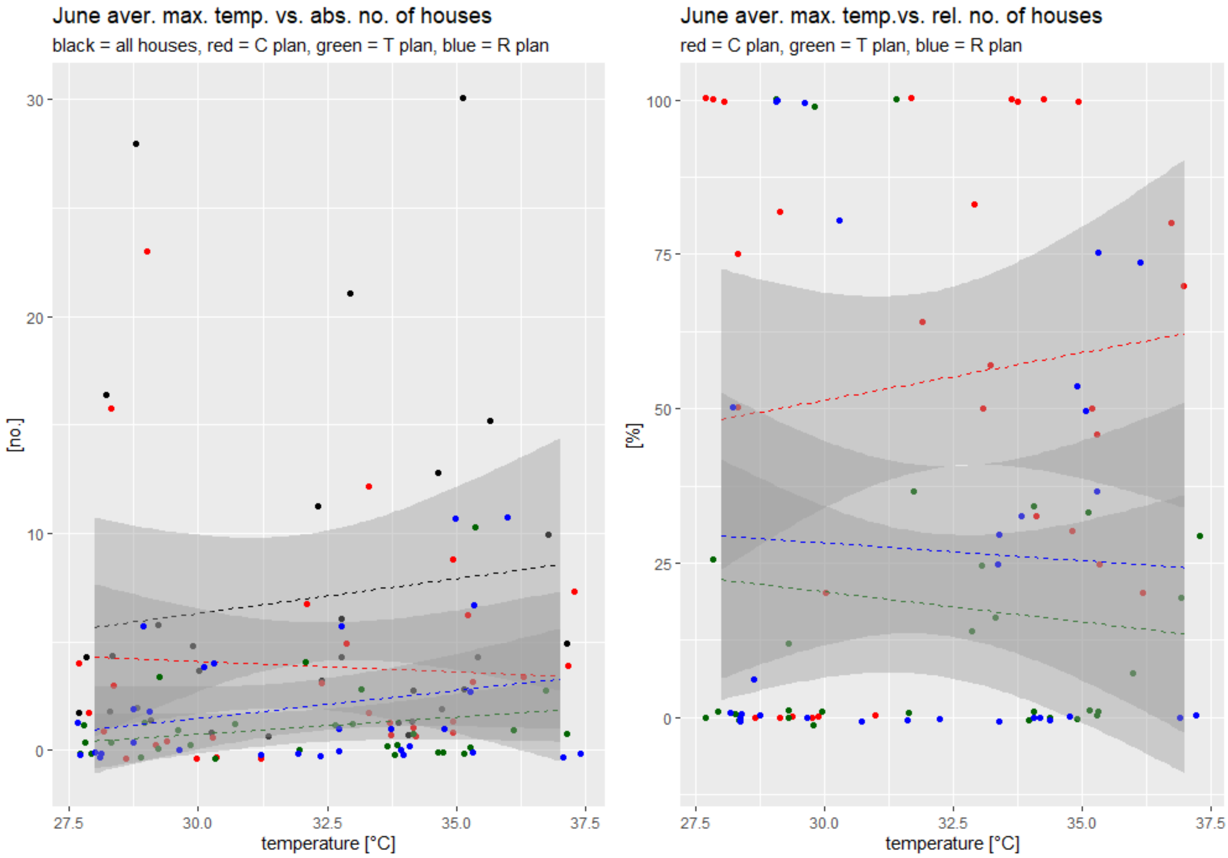

Fig. 35: Distribution of individual house plans according to the maximum June temperatures (absolute and relative numbers of houses)

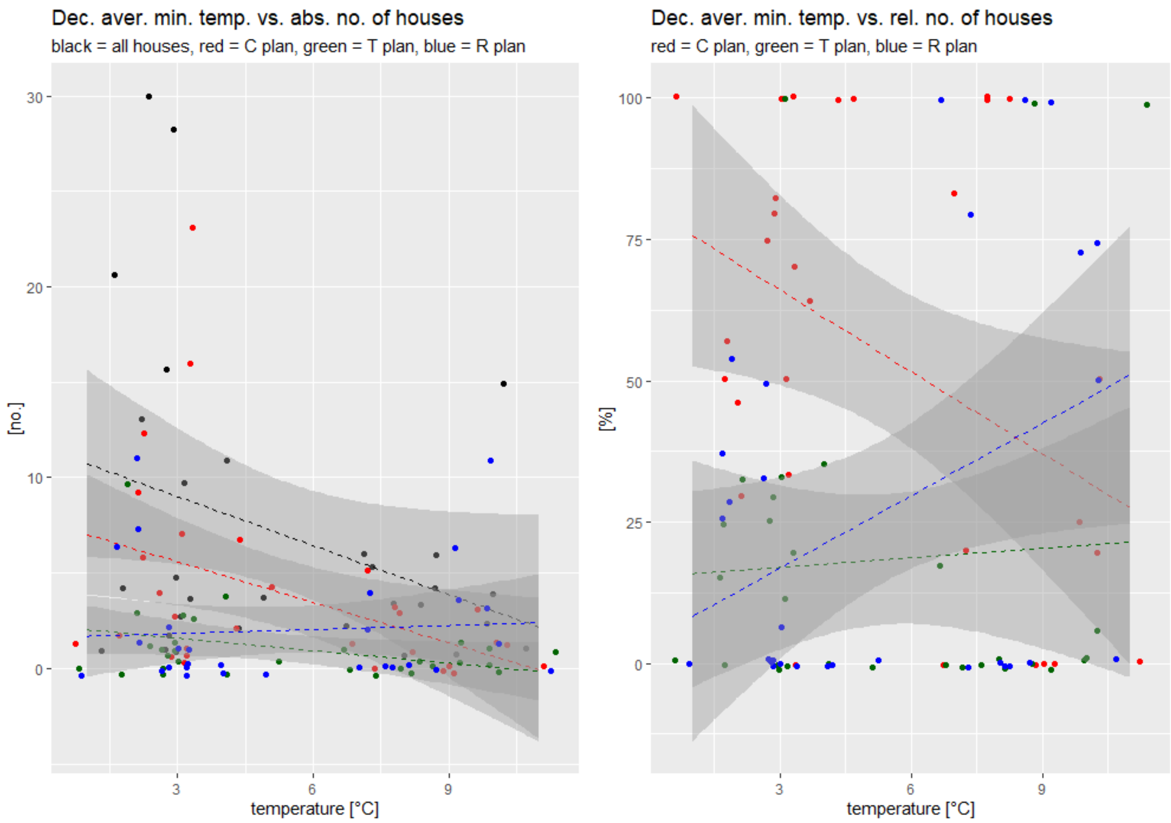

Fig. 36: Distribution of individual house plans according to the minimal December temperatures (absolute and relative numbers of houses)

Environmental zones

The results of evaluation the ratio of the representation of the individual plans in different environmental zones[8] relatively correlates with the previous results stated above. The circular plans prevail throughout all zones which correspond with the numerical superiority of this type of plan in general. The highest number of evaluated buildings occurred in the Iranio-Turanian zone, probably because of the presence of a high ratio of RA3 and RA2 sites, including the biggest like Beidha, Jerf el-Ahmar, or Tell Qaramel.

However, a distinct trend is apparent, concerning the more frequented circular plan in Saharo-Arabian, and Sudano-Decadian zones and relatively striking occurrence of rectangular shapes in Mediterranean and Iranio-Turanian zones. The most frequented presence of transitional ground plan is apparent in Iranio-Turanian and, a bit surprisingly, in Sudano-Decadian zone, while the ratio of transitional plans in the Mediterranean zone is negligible.

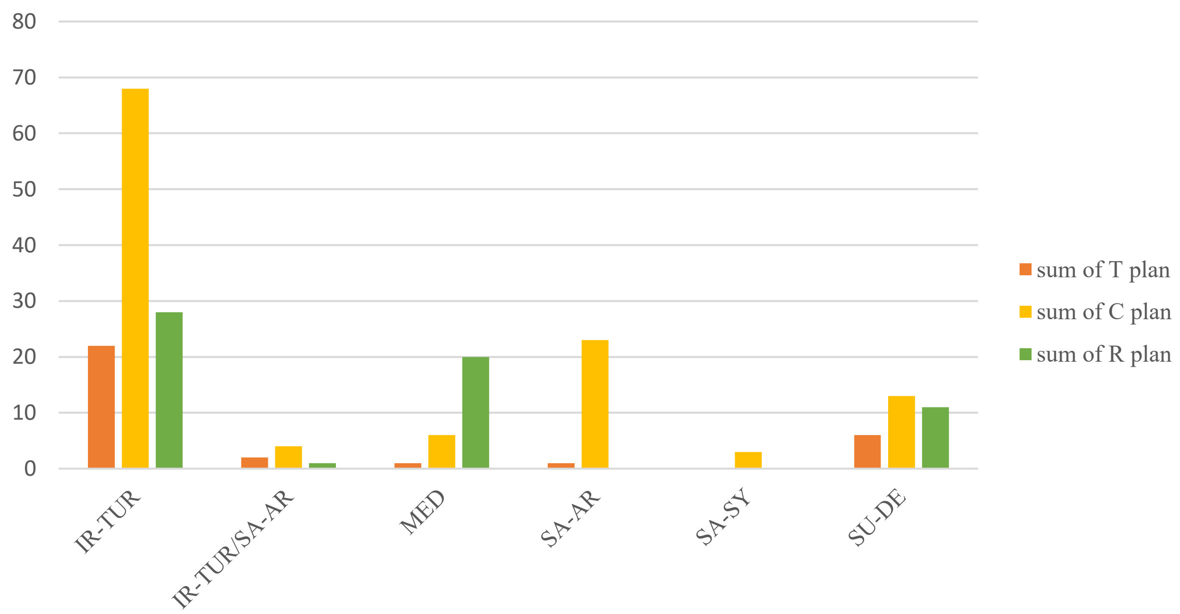

Fig. 37: Numerical representation of individual plans in different environmnetal zones

[8] Each closely described in the “Environmental chapter” above

3.3 SUMMARY AND INTERPRETATION

The evaluation brought several findings, which unfortunately do not provide a wholly clear picture of the situation. The original assumption of the possible influence of different environmental conditions on the change of houses ground plan showed a clear correlation only in the precipitation model.

A distinctly increased occurrence of circular buildings in the arid areas with the less precipitation rate and favouring more humid territories by rectangular and transitional shapes confirmed the clearly recognizable pattern apparent throughout the Levant.

In general, it is supposed that this division on the arid areas with circular houses and more humid territories with the right-angled buildings reflects a different subsistence strategy of societies occupying individual areas (e. g. Edwards 2016. 67), or that this change might correspond to the increasing permanence of settlements (Goring-Morris – Belfer-Cohen 2013, 26). This conclusion accords with the fact, that a huge amount of these circular, often "beehive" arrangement buildings were of seasonal, or partly seasonal use, a camp-like or hunting stations (e. g. Ain Abu Nukhayla, Abu Salem).

The correlation between circular plans, arid areas, and the seasonal of the settlement is not valid unconditionally: several sites with the prevalence of non-rectangular houses (e. g. Shkarat Msaied or Nahal Reuel) are typical permanent village-like settlements but still preserving the circular ground plan. These sites might only follow the building tradition in the area, regardless of the socio-economical changes.

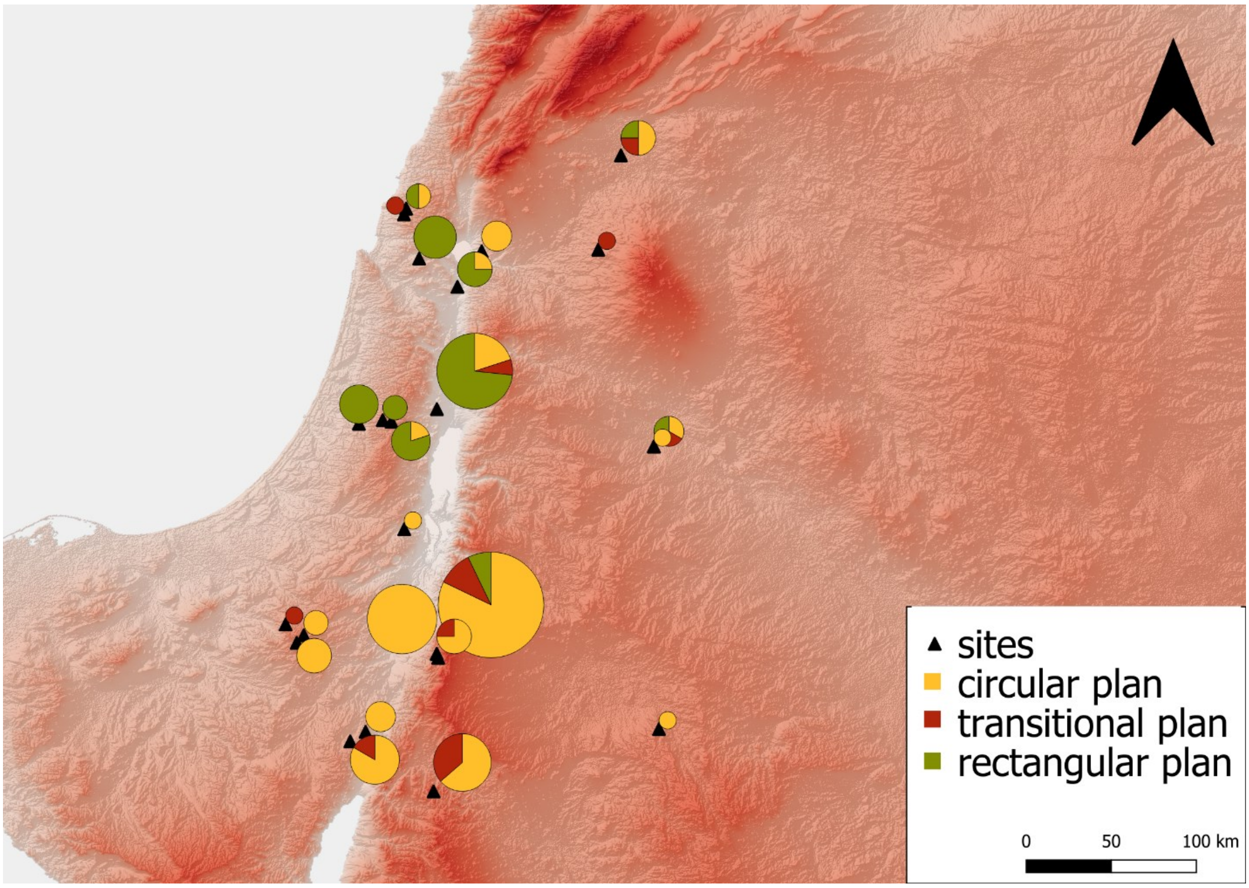

Fig. 38: Spatial and numerical distribution of individual plans on the southern Levantine sites

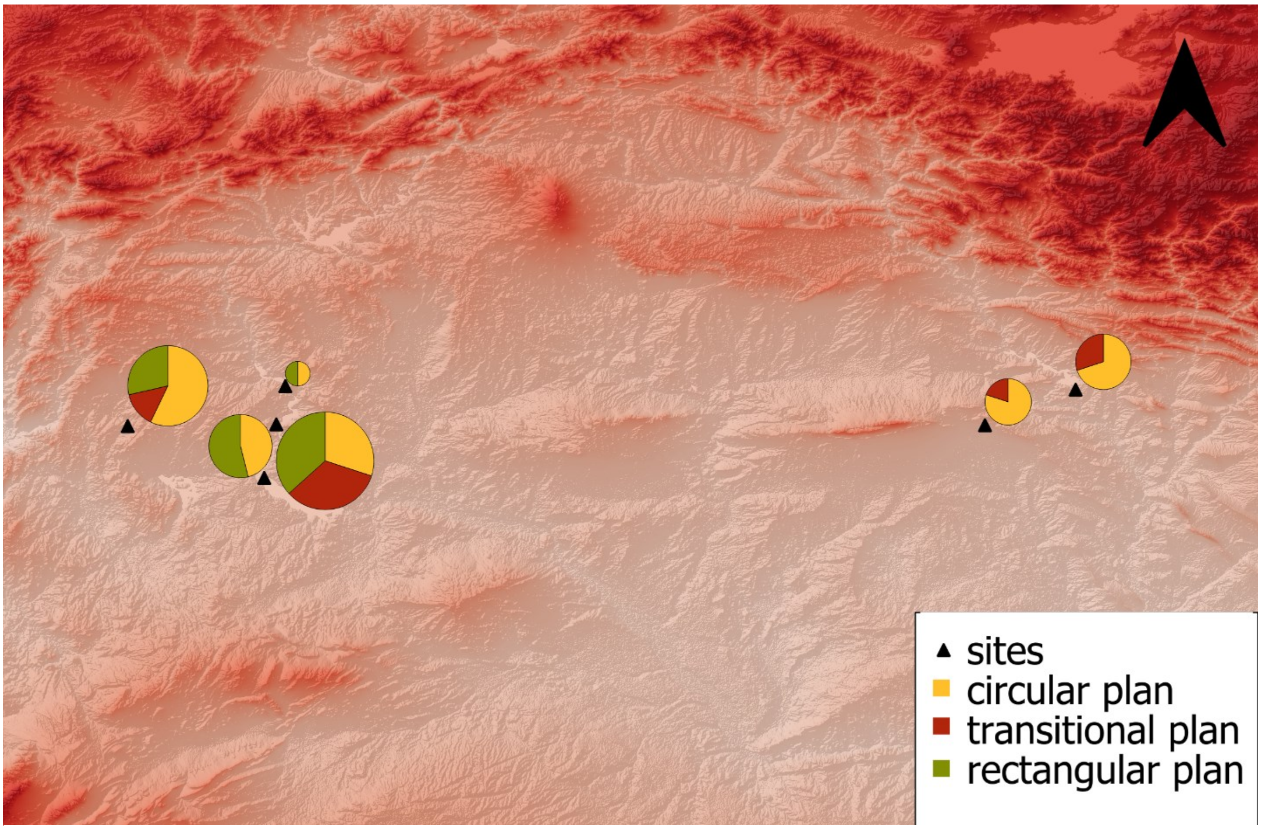

Fig. 39: Spatial and numerical distribution of individual plans on the northern Levantine sites

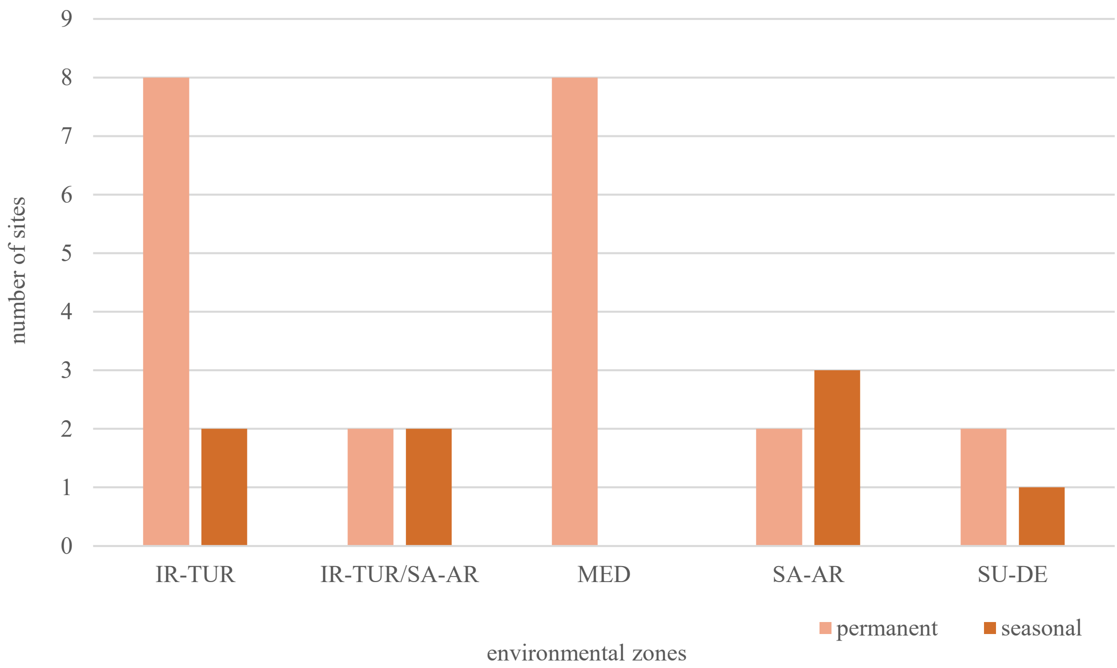

Fig. 40: The ratio of permanent and seasonal occupation according to individual environmental zones

The relationship between subsistence strategy and different environmental zones is closely related to the plentiful adaptations of various societies in individual environmental microregions. Such diversity is characteristic especially for early and middle PPNB settlements, which is besides reflected in the variation of plan types.

Concerning the southern Levant, two groups might be defined, both from the architectural and socio-economical view, "woodland and steppe" (Betts 1989, 147).

According to Betts (1989), as a "woodland" group, societies operating within a broader Mediterranean environment are considered, while under the "steppe" group semi-arid, highland steppe, and arid environmental areas are included. The main difference lies in the change of variability the subsistence strategy. Its is distinctively higher within the steppe group, unlike the Mediterranean zone adaptation, characterized mainly by the large-scale sedentary farming and herding village-like societies (Birkenfeld – Goring-Morris, 2013, 83). On the examples from eastern Jordan or Negev highlands (e. g. Wadi el-Jilat 7), the economy includes mostly the mix of hunting/gathering/proto-agricultural economy pattern, in later PPNB phase combined with sheep/goat pastoralism. The settlement pattern apparent from the eastern Jordan is similar with for example semi-arid

Sinai characteristic by cyclical movement, reusing existing structures, all typically circular shaped (Betts 1989, 149).

Within the desert periphery of southern Levant (Negev, Sinai), some assume three types of societies: a) self-sufficient groups, moving over highlands to lowlands on a seasonal basis, b) societies, based in Mediterranean zone and only sending groups south to exploit more arid areas again on a seasonal basis or c) small resident population in the more arid regions, interacting with the supplemented Mediterranean zone (Gopher – Goring-Morris 1998, 17).

This variability reflecting the difference of these two environmental/economical groups is manifested by architecture in middle PPNB the best, according to the already existing fully developed right-angled house form in Mediterranean areas.

The situation in the northern Levant does not provide such a clear picture. The northern Levantine area consists of Mediterranean and Irano-Turanian environmental zones, which are characterized by less extreme climatic conditions as a semi-arid and arid conditions of southern Levantine steppe/desert areas and Saharo-Arabian zone. Therefore, concerning the socio-economic existence of early and middle PPNB societies, the overall picture seems to be more homogenous. According to the database of early and middle PPNB sites evaluated in this thesis, the permanent and village-like settlements unequivocally prevail within the northern Levantine range, with only one exception (Djade al-Mughara).

On the other hand, this extremely broad area displays a high variety by individual microenvironmental regions. However, these differences within the northern Levantine environment are not manifested so distinctively in settlement patterns as in the south, at least not in the period of early to middle PPNB. Therefore, the subsistence strategies apparently do not provide such a clear solution for the change of the architectural changes, including the ground plan.

According to a not clear conclusive model of the environment influencing the houses shape through the different subsistence strategy, also already proposed social explanation exists. A relatively detailed detected transitional phase between circular and rectangular shapes at Tell Mureybet was explained by Ibañez (2008) by a change of village organization (Ibañez 2008, 674). He describes the right-angled shapes as a key innovation differing the Mureybetian population from the previous Natufian and Khiamian of PPNA. At Mureybet, and similarly, at Jerf el-Ahmar, two main architectural trends are distinguished: the traditional, circular, or oval public buildings, constructed on the ground, and sunken rectangular domestic buildings. This new type is supposed to have three functions: a) utilitarian, mainly for storage, b) social and c) symbolic. These "multi-purpose" buildings are considered as symbolic "holders" of farming products represented by individuals or collective, however, as an authority controlling all over the collective work necessary for cultivating and harvesting. Also, speculation about the role this hypothetical institution playing in the consolidation of the earliest agricultural experiments exists (Ibanez 2008, 674–75).

Although the precipitation model obviously brought the clearest correlation with the ground plan change, yet the altitude model should be assessed too. The conclusiveness of the statistical evaluation is not high, especially concerning the transitional and rectangular plans. Also comparing the sites with the highest occurrence of transitional plan does not show a clear picture (Jerf el-Ahmar, Ain Abu Nukhayla, Beidha, Tell Qaramel, Nemrik 9): the individual altitudes are diversified and ranging in a relatively wide range from 1020 m asl (Beidha) to 345 m asl (Nemrik 9).

In the case of altitude influence, different access to subsistence strategy might be considered as well. This model is declared by the probable transhumance at the Ain Abu Nukhayla site when the long-term winter camps in higher elevations existed (800-1000 m asl) (Henry et al 2003, 25–26). This site represents an exception within a ground plan distribution: despite of the seasonal character of the site, the transitional plan occurrence is relatively high (four from seven houses in total). However, such a ground plan pattern is rare and the hypothetical correlation of transitional shapes with transhumance is highly speculative.

The overwhelming majority of the seasonal settlements are defined by the circular shape of the buildings, differing them from the permanent village-like settlements, including the subsistence strategy, as stated above. For proving an idea of hypothetical connection between the seasonal shifting between different altitudes and the change of the house shape, more detailed research of similar early Neolithic transhumance sites would be necessary.

For now, the altitude does not seem to represent a relevant factor for the change of ground plan.

4. CONCLUSION

Within this thesis, a question of the possible relationship between the change of the ground plan from the circular to the rectangular and the environmental conditions was discussed. Another part of the question of buildings shape transition was represented by the issue of the commencement and development of right angle across the northern and southern Levant from the chronological view. These two courses of research were evaluated independently, however, they became entwined at the final assessment.

30 sites in total from northern and southern Levant were evaluated, which were chosen according to the two main criteria: the chronological range from the late PPNA to the middle PPNB, or the presence of the transitional ground plan. From these sites, a database was created which is included as a supplement to this thesis.

From the architectural variables, three types of ground plans (circular, transitional a rectangular) and the frequency of their representation on each of the individual site was evaluated. The frequency of each type was expressed both in absolute, and relative numbers, in percentual values. Besides, a chronological categorization was the part of the evaluation, expressed by the radiocarbon dating, if accessible, or by the stone industry. The individual ground plans were categorized according to the source literature, or my own evaluation. The database including other information, such as individual house sizes, or the building material, which were not included into the final assessment, nevertheless.

The environmental variables consisted of the altitude, the annual monthly precipitation (June, December; mm/month), the annual monthly temperature (min/max June and min/max December; °C/month), and the environmental zone (Mediterranean, Irano-Turanian, Saharo-Arabian, Sudano-Decadian, Saharo-Syndian).

The evaluation exposed two main problems which possibly partly affected the final results. Firstly, the total number of tested sites was relatively low to provide reliable statistical analysis and each site had a different rate of accuracy (i. e. different number of evaluated houses), ranging from relatively plentiful (Jerf el-Ahmar) to extremely underrepresented sites (Tell Qarassa). These two factors, and especially the different RAC values might strongly affect my evaluation.

The examination of the chosen sites according to above mentioned environmental variables, the chronological classification, and the subsequent comparison within the northern and southern Levant brought several findings:

1) The northern Levant and especially the area around the middle Euphrates seems to be the core area of the right-angle commencement, according to the high rate of transitional shapes on northern Levantine sites, and, also the supposed southward spreading of rectangular buildings was confirmed.
2) The chronological range must have been extended from the previous intended early to middle PPNB phase, by adding the late PPNA period. This extending showed, that in the core area of northern Levant the change of ground plan should be connected more likely with the PPNA – PPNB transition than with development during the PPNB period.
3) Assessing the environmental factor showed the only conclusive correlation by the rate of precipitation. The analysis proved the generally accepted model of right-angled buildings in more humid areas and circular-shaped houses concentrating in semi-arid and arid environments. Such a layout is probably connected to the different subsistence strategy which is linked to the certain architectural manifestation. However, this model seems to be valid more likely in the southern Levant, while the northern areas do not evince such a high variability in the type of building and subsistence strategy within the period of MPPNB. Therefore, the evaluation of character of the environmental influences is less clear in the north. When evaluating the environmental factors manifesting through the subsistence strategy, both Levantine areas should be assessed viewed independently then.
4) A second considered environmental factor, the altitude, did not show a conclusive correlation, unfortunately. The statistical analysis did not prove any meaningful relationship between the diverse altitude and the ground plan change, according to the high variability of altitudes regardless of the transitional plan occurrence. The assessment of seasonal highland camps in semi-arid areas characterized by mostly circular ground plan and the rare occurrence of transitional shape within this environment suggests a possible question about the relationship of transhumance, seasonal occupation, and the settlement model.

Besides the findings stated above, a relatively complex database was created, providing a base for potential subsequent research.

In the case of further research, the scope of this topic would require an extension of the observed area from Levantine territories to Anatolia and Taurus-Zagros area as well, to get a wider range of samples for evaluation and reduce the difference of individual sites relevance. Also, more detailed research of environmental microregions would be appropriate, exceeding the four-zones model used in this thesis. Besides, critical examination of each site including another factor, such as building material could be involved (similarly as Tell Qarassa; Balboa 2012)

Such an assessment exceeds the size of this thesis, however, this first evaluation opened some stimulating questions though, which should be examined within a wider area.

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